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- HOW IT'S DONE
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cover for details).



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(See page 57 for details).

Cover caption: The Robobeast is just one of the homegrown 3D printers (and innovative ideas) to emerge from South Africa's flourishing maker community. This page: drill drivers are useful for putting things together; we take one apart. See Skills on page 71.

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ESKOM, CONSIDER YOURSELVES SHED.

ALL RIGHT. THAT'S IT. I GIVE UP. ESKOM, YOU WIN.

Call me naïve or a hopeless optimistic, but I really, *really* wanted to be simply able to flick the light switch and have the lights come on.

Yes, over the past few years POPULAR MECHANICS has urged everyone to be more efficient and responsible about using electricity. We offered alternatives and ideas about renewables. You probably followed some of our advice. I know I did.

We swaddled the geyser at home in a purpose-designed blanket. Then we installed LED replacements for our energy-hungry halogen downlighters. Similarly, LED bulbs in the bedside and accent lights. They're surprisingly well priced these days and they save lots of electricity.

You know, electricity. The stuff we're being urged to use less of, when it's available.

Welcome to winter 2015. We're in for a hard winter of load shedding. Followed by a hard spring of load shedding. And more to follow. Much more.

In response, we need to use less, we're told. Well, a business that urges us to use less of what it produces is, surely, doomed to go out of business.

Frankly, it's become intolerable.

I realise now that the voice of apparent reason echoing into the silent darkness was only me rationalising. In among all this responsibility and efficiency, I suppressed – as long as I could – the rising impulse to get our house all generated and inverted and solar powered and off the grid. After all, we live in the industrial powerhouse of Africa, I said. Our guys are doing their best to keep the lights on. We've rolled out electricity to many millions who didn't have decent access before. Going off-grid would be an admission of... well, of defeat.

So I admit defeat. And helping to tip me over the edge, reader Mike Mollatt this month writes that backup generators are a great idea, but in crowded suburbia he foresees "generator rage" sparked off by the unavoidable racket. What's needed, he writes, is authoritative guidance on home battery back-up systems.

Sounds like a plan. By the time you read this, with any luck I will have done the research, done the shopping and done the installation.

Come to think of it, that might even make a good story. We could use a few of those.

Anthony Ramsay

anthony@ramsaymedia.co.za



DIY CHALLENGE NO. 2



The number of entries for our DIY Challenge No. 2 suggests that putting together a joint adult/child project was mildly taxing. In the end, we went with a project whose complexity can range from Easy to Reasonable to Insane, depending on your familiarity with Newton, Archimedes and a bunch of other dead guys who knew about fluid mechanics. What it may lack in finesse, it more than makes up for in involvement and interesting *stuff*.

And DIY Challenge No. 3? See your July 2015 POPULAR MECHANICS for details. As before, there's a great prize from Makita up for grabs.

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BRIGHT IDEAS DEPT

WINNING
LETTER

Firstly, for years now I've been looking at flour and cement trucks (the ones that look like a bent sausage, with the bend in the middle showing up or down) and thinking, what a lot of wasted space. Maybe the solution is to install fluid tanks in the wasted spaces. Cement can be transported with diesel, and flour with vegetable oil. If the latter vehicle has an accident, just add eggs and milk and bake a cake! Secondly, I regularly see people failing to notice the flashing green arrow when turning left or right at an intersection. Maybe the design should change to allow amber and green lights to flash alternately (something like what you'd get at a railway crossing), which should catch the eye better. In fact, has research been done to determine if the colours used for traffic lights are the best suited for the human eye? The green, amber and red have been with us since Pa fell off the bus.

Thirdly, I asked my friends on Facebook (Weskus Vriende) what amount of power a ship could generate. A large ocean liner must be able to put out a considerable amount, as these things are like small cities. I was thinking along the lines of these ships, while in harbour, being coupled up to our grid to help old Eskom a bit. One of the friends mentioned that there are purpose-built nuclear ships that have the sole purpose of generating power. If we can get 3 or 4 of these babies docked in our key ports, they could supply enough power until Eskom has sorted out its mess. It could be cheaper than importing power from our neighbours.

Finally, has any other research been done in South Africa on the use of wave/sea movement to generate electricity?

ANDRÉ PIENAAR
BRACKENFELL

Write to us, engage us in debate and you could win a cool prize. This month's best letter will receive a **HTSE** watch developed by **TITAN**, valued at R3 750. **HTSE**, or High Tech Self Energized, is a collection of futuristic, light-powered watches developed by **TITAN**. These watches can be charged by any light upwards of 200 Lux. **HTSE's** design inspiration is from some of the most complex self-energising bodies built by mankind: space ships, orbiting space stations and satellites. **HTSE** watches' impressive array of features includes End of Life (an indicator of battery charge), Sleep Mode (increases shelf life of the battery) and Over Charge Prevention (protects the battery). **HTSE** – for those driven by technology. To find out more, contact Luxco on 011 448 2210 or www.luxco.co.za

Send your letter to: **POPULAR MECHANICS**, PO Box 180, Howard Place 7450, or e-mail popularmechanics@ramsaymedia.co.za Please keep it short and to the point. Regrettably, prizes can be awarded only to South African residents.

LIGHT ON LOADSHEDDING

I am sure many of your readers will resonate with Steve Caulley's letter ("Load-shedding how-to", March 2015). I would strongly support his plea for authoritative guidance on home battery back-up systems.

Over the years PM has covered a wide range of subjects on energy efficiency and renewable energy options, and there is no doubt you have grown awareness among your readers of responsible usage of grid-supplied power and the benefits of (increasingly accessible) solar water heating and photovoltaic alternatives. The advice con-

tained in these articles has, I am certain, been applied by many concerned individuals and their families countrywide. I am also certain that most of those individuals, having heeded your recommendations to the letter, will be your strongest ambassadors; those who have taken shortcuts may well have fallen at the start.

With the rolling blackouts we are beginning to experience, against a backdrop of assurances from Eskom that things will get worse before they get better and that the time-scale is measured in years rather than months, I see a pressing need for your

tutelage to focus more sharply on grid independence. My opinion is based not merely on serving the unthinking needs of households who are not accustomed to power outages, but perhaps more importantly on emphasising the need for us all to contribute to conserving energy; to understand the need to apply priority to those consumers whose activities are clearly beneficial to the country as a whole.

To emphasise this point, which is more important: to use kWh brewing countless cups of coffee at home or, with a thermos flask, to store boiling water, to allow access to power thus saved to commercial, industrial and emergency services?

I would like to suggest that there could be parallel areas of interest, particularly topical as we each consider practical ways of overcoming grid power loss. For instance, I picture many families identifying petrol/diesel gensets as the solution to our woes. Although that may be so, has any thought been given to the urban community where every household starts up a generator when the power fails? The noise pollution on smaller properties would be horrendous. Think "generator rage" between neighbours. So, articles on quietening small generators without undue loss of power or cooling would be good, in my view.

Other areas of interest:

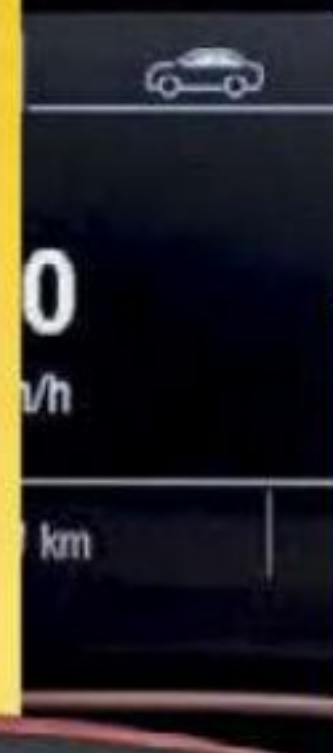
- The dangers associated with DC/AC voltages and the legal issues surrounding unqualified interference with domestic mains distribution boards.
- Alternative energy systems/devices for urban dwellers – for instance, induction cooking.
- Thermal generation, particularly useful in winter when heat from the family fire-place simply escapes unused up the flue.
- Comparative efficacies of cold-wash vs hot-wash detergents.
- Advances in LED and other energy-efficiency technologies.

MIKE MOLLATT
BY EMAIL



MORE THAN JUST TEA

Further to the article on rooibos tea (April 2015), the amount of Rooibos that should be consumed per day is not a scientifically



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measured 6 cups per day, but the amount of Rooibos available concentration of the active antioxidant ingredients. This is measured by the oxygen radical absorbance capacity (ORAC) value.

The human studies that showed the health benefits were on standardised rooibos extract of plus/minus 8 400 to 8 500 ORAC per 6 cups. Commercial rooibos varies from 400 to 1 200 ORAC per tea bag. So, for a start, you would need at best 7 cups of good Rooibos to match the study, but more likely 10-12 cups, based on the average commercial Rooibos grades available on the shelves.

The quality of the Rooibos harvested may be attributed to many factors. Here are a few:

- **Plant genre**
- **Geophysical location:** area and facing, height above sea level, average temperature and rainfall
- **Soil quality**
- **Stresses on the plant** that cause it to produce more self-defence mechanism (these are, 99% of the time, the molecule of interest such as aspalathin)
- **Harvest time** (month and time of day



LEFT, RIGHT... WRONG

If you drive Ford, Isuzu, Toyota, VW, Kia, Jaguar or any other vehicle on Earth, the clutch pedal is always left foot, and the brake pedal on the right, with the petrol on the far right. No confusion.

If you drive the same makes and need to dim your lights, unexpectedly you squirt water on your windscreen and the wipers go on! Why can't all car manufacturers be the same – indicators left, wipers right?

When you drive a lot, you don't think. You drive subconsciously. This can cause accidents.

GOMMIE PRINSLOO
BY EMAIL

as well as temperature and humidity)

- **Time allowed for the rooibos to ferment**
- **Fermentation methods and conditions.** Most important of all is the correct method to halt the fermentation so no decay happens during any continued fermentation
- **Storage conditions.**

We have looked at food, cosmetics and other products. There are many rooibos teas and other products on the shelves that we have found with greatly varying qualities. Our company processes rooibos (and other foods) using our DCD (Dynamic Cell Disruptor) plant, which typically yields 5 times the normally available ORAC value.

If you and any member of your family is purchasing a rooibos, aloe, or any other product of this sort and there is no ORAC value on the label, then, well... what are you buying?

LOUISE SPILKIN
BY EMAIL

WHY NOT BIOMASS?

It seems to me that, whenever I open a publication or watch media on alternative energy, it is usually all about solar, wind, fuel cells or other expensive methods. Please don't get me wrong. There is a time and place for all of these methods of generating power off the grid.

There is one method that seems to have been "bogged down", so to speak, beneath the hype, to promote the more glamorous alternative energy systems. I am referring to biogas generation. In countries such as China and India, this method is one of the most widely used of all the alternative energy generation systems.

The only substance on Planet Earth that is steadily increasing is human and animal waste. The principles behind biogas generation are decades old, tried and tested. Biogas generators can be built from a JoJo tank and some PVC piping. These systems can be installed and maintained relatively inexpensively, although they do require a bit more attention than your solar panels.

The waste product from these generators or digesters makes a great fertiliser. The methane gas is used either directly as cooking and lighting gas, or to power electrical generators. One is not restricted to bodily waste products either. Any biodegradable material can be used.

Sometimes, less is more.

DAVID KRUGER
BY EMAIL

POPULAR MECHANICS FTW*

I found it most astonishing that the question of changing the name of your excellent

magazine should even breach the threshold of consideration. Firstly, the use of this name as a banner for the magazine has put it on par with names such as Coca-Cola, *Washington Post* and *National Geographic*, to name some well-known titles. To change, no matter how appropriate the new name might be, would lose that standing built up over the decades. As with many of the well-known brand names, yours conjures up the expectation of a consistently high standard in the dissemination of knowledge of "how things work".

Secondly, I believe that in the broad approach the meaning of the word "mechanics" has expanded over time to cover the question of how *all* things work, whether they be geared motors and machines, energy systems, political and legal or many other matters affecting our daily life. Researching the meaning of the word "mechanics" and associated phrases such as "mechanics of" in dictionaries, Google or Wikipedia could keep one absorbed for hours.

So, although change is a fact of life, I believe we should rather be looking for the expanding meaning and concepts covered by the "mechanics of things" in this exciting world of ours.

RICHARD TURNER
SANDTON

(*Yes, we speak geek – editor.)

DON'T BE HAPPY, WORRY?

The chilling article "This man will save you from the evils of the Internet" (March 2015), warrants a response.

The hacking of global information systems, by major powers and institutions is a matter of grave concern. If cyberspace itself is now a weapon of mass destruction, how can we protect ourselves from an electronic Armageddon?

Cyber attacks against global corporations have been widely reported. In July 2012, 450 000 user names and passwords were compromised. There are a million new viruses every year. Some advanced nations report 1 000 attacks a minute.

If you want to devastate a country's industrial infrastructure, cyber technology can do this without firing a single missile. A full-scale global cyber war is now in progress.

During 2010, breaches occurred in many corporate firms that cost hundreds of thousands of rand to repair. It took more than a year for some of them to recover their corporate image. A cyber 9/11 will strike one day, with staggering consequences.

FAROUK ARAIE
JOHANNESBURG **PM**



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how can we help you?

1955

While researching our May 2015 cover story, *Supertrains*, we thumbed through the archives for inspiration... and found plenty.

Back in 1955, it seems, trains were big news.

In September 1955, our cover declared: "Ten buses grow into a train". Suggesting that necessity was indeed the mother of invention, the idea grew out of that age-old problem: how to turn a sow's ear into a silk purse. Or, on a less idiomatic note, how to make your expensive, slow product (trains) compete with alternatives that are fast (planes) and cheap (buses) – and, by the way, use existing parts.

The result was the Aerotrain.

But the General Motors execs who brainstormed the Aerotrain had overlooked a vital truism: buses aren't trains. Or planes.

The bus bodies on railway running gear were cramped and rode badly compared with regular trains. Yes, they were lightweight, which allowed smaller, more economical engines to be used in the space-age, streamlined locomotives – but the ultimately underpowered locos proved to be false economy. Built in limited quantities, the concept remained on the tracks for just 10 years before being quietly retired.

Our January 1955 cover posed the question, "Is this the last stand of the Iron Horse?"

The Iron Horse story detailed the workings of the mighty Norfolk and Western No. 2300, below. Imagine a power station on wheels: its coal-fired boiler produced high-pressure steam to drive a turbine that developed 3 350 kW at an electric generator supplying power to 12 traction motors – one for each axle. It was designed for the heavy work of hauling coal over the Appalachian mountains of the US Northeast. At the time, diesel power was in the ascendancy and Norfolk and Western was the only big railroad in the US that stuck to steam for all freight and passenger operations. To answer our question: Yes.



In the "Popular Mechanics Craftsman" section of January 1955, we found takeaway trains, aka Railroad In A Suitcase. The brainchild of PM art director and model-railway enthusiast Frank Beatty, this DIY creation was a mini-railroad that folded up into the dimensions of an oversized suitcase 1,2 metres square. Encased in plywood, its clever features included a hollow mountain used for storing rolling stock, screw-in legs and fishplates or jumper wires to maintain the connection across the joint in the plywood. **PM**



* Rare find or lemon? Context matters.

While on the surface things may look good, it is only once you look deeper that you understand whether something runs the way it should.

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Sensors in the 545-gram Samsung Gear VR combine with accelerometers in your smartphone to make virtual movement feel real.

MY WEEK IN VIRTUAL REALITY

With the recent launch of Samsung Gear VR, virtual reality can finally be brought home. But do you want it?

BY ALEXANDER GEORGE

PHOTOGRAPH BY DEVON JARVIS

VIRTUAL REALITY



✓ Stupid or □ amazing?

< **COOLPEDS BRIEFCASE ELECTRIC SCOOTER:** Luggage you can ride, depending on your self-respect.

THE COCKPIT OF A JET FIGHTER, Angkor Wat, a Paul McCartney concert – I visited all of them without wearing pants. Those weren't my first experiences with virtual reality. I'd tested the Oculus Rift at tech conventions, and recently I explored a Volvo that wasn't on the road yet. (For Ezra Dyer's take on VR in a Volvo, turn to our Wheels section). But I never got to bring virtual reality home and try it from my couch. Samsung Gear VR gave me that opportunity.

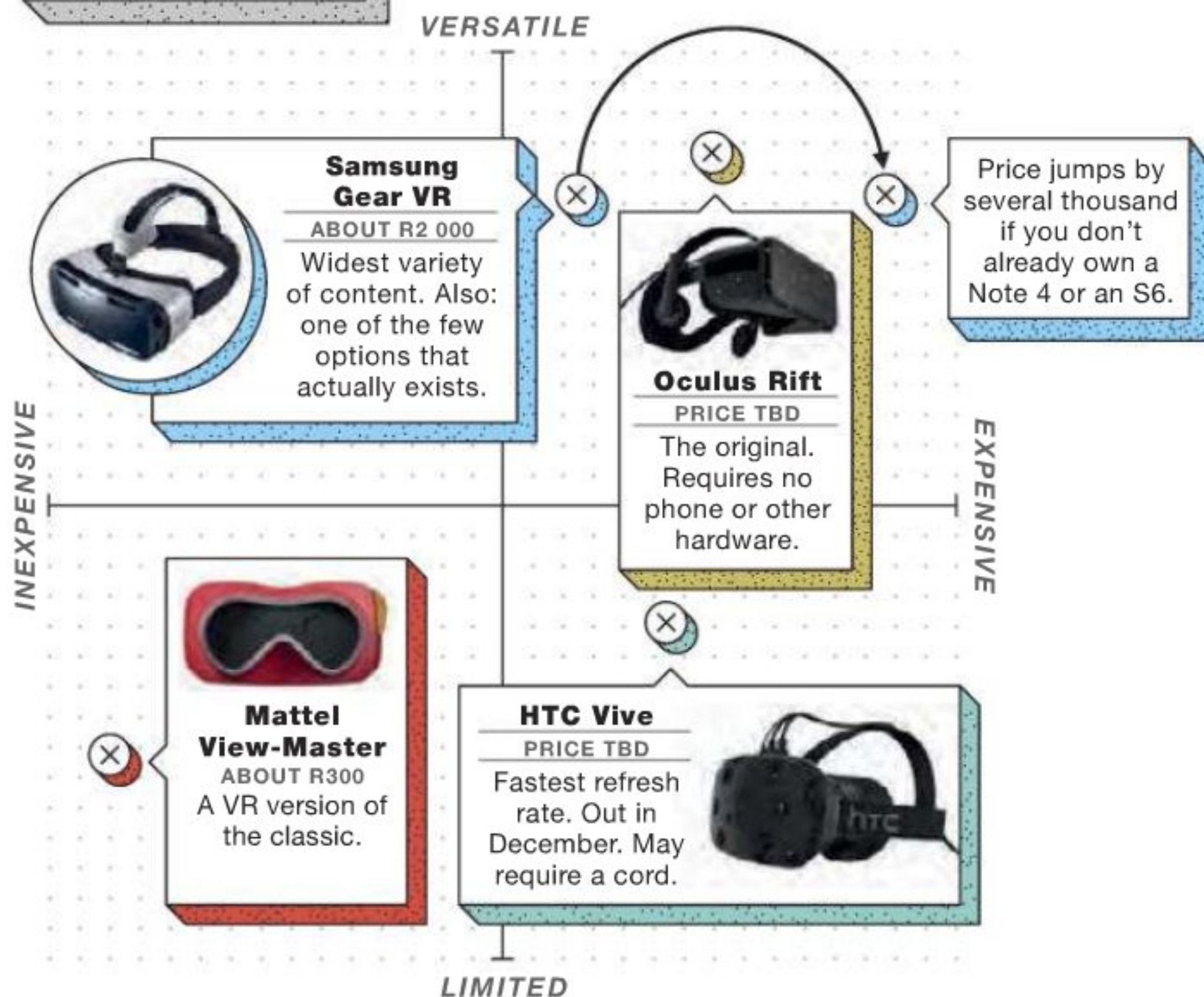
The device requires a Samsung Galaxy S6 or Galaxy Note 4 phone, headphones and, if you want to take full advantage of the games, a controller costing about R700. (Also important: a swivel chair.) The phone slides into a compartment of the headset, where two lenses magnify its image to fill your field of view. You control a cursor by moving your head, and click to access programs through a touch panel over your right temple.

Although VR has been around for decades, mostly in arcades, the at-home product is still nascent. All you can really watch is short content. But there is some variety, and I was determined to experience everything VR could do.

Within the first few days I'd been through all the safari videos and dune-buggy ride-alongs in the Oculus Store (an app accessed through the headset), but the sensation of all of them is so stunning that I wanted everyone I knew to try it.

VIRTUAL REALITY

A SPECTRUM OF OPTIONS



Showing my mom a 360-degree photo of Petra, Jordan, a city she visited decades ago, made her want to travel again. One friend bemoaned a future where everyone will wear these things. Another asked about the Runtastic VR workout app and was disappointed to discover that the headset didn't stay fastened during a burpee.

I wanted to try creating my own experience, so I found a panorama app (360Cities), photographed the POPULAR MECHANICS offices, and loaded it on the Note's SD card. I was astounded when it actually worked. I could look around our headquarters, albeit with a warped ceiling and floor where the camera stretched the photograph. It wasn't high-quality, but strapping a VR-capable camera to my surfboard and reliving a thrilling wave feels imminent.

Right now, however, where the technology really shines is in movies. Plain old 2D movies. Netflix doesn't work on the Gear VR, so finding a compatible movie meant using a file converter of dubious legality. I ripped versions of *Enter the Void*, *The Red Balloon*, and clips from *2001: A Space Odyssey*, then had to transfer them to the Note and the Oculus Cinema app via the SD.

The app doesn't do much – it adds a layer of digitised seats in front of you and makes the movie look like it's projected on a huge screen. But that's all I needed. Each movie stirred up everything I love about being in a theatre. The trippy and exhilarating opening credits to *Enter the Void* made me shiver, especially when I looked to the side and saw the red velvet chairs reflecting the screen's flicker. The best part is that distractions aren't an option. I can't be tempted to catch up on Instagram or return emails during a lull in the action. Inside the Gear VR, you're forced to do nothing but watch the movie, something many of us have forgotten how to do.

It's only going to get better from here. Oculus is working with Pixar alums to produce immersive films within the year – an entirely new medium in which you're not just watching a movie, but living it. And with Jaunt and Bubl, two 360-degree-camera makers, you'll soon be able to make your own immersive films, too. The only unsolvable issue is how weird it will always feel to take the helmet off – a little like walking after running on a treadmill or jumping on the ground after using a trampoline. But coming back to reality has never been easy.



MICROSOFT HOLOLENS



EPSON MOVERIO BT-200

THE OTHER REALITY: augmented virtual reality completely immerses your vision, whereas augmented reality overlays digital images on it. Although Google Glass was discontinued, Microsoft's new HoloLens and other recent products are taking AR in a more useful direction. As part of a trial, engineers at Lockheed Martin are using R8 000 glasses made by Epson to perform maintenance on F-35 fighter jets with virtual assistance. Look at a brake component and you see step-by-step animated instructions. No need to double-check the manual.

SPACEX'S REUSABLE ROCKETS

BY JOE PAPPALARDO

ON THE VIDEO IT LOOKS LIKE A ROCKET LAUNCH played on rewind: a slender, fourteen-storey aluminium-lithium-alloy tube, engines spouting fire, comes to Earth instead of roaring into space. Then, calamity. The footage from January shows the rocket veering at a too-sharp 45-degree angle, then exploding. That was the fiery end to the initial attempt by Space Exploration Technologies (SpaceX) to land the first stage of a Falcon 9 rocket for reuse on an unmanned ship floating in the Atlantic off the US east coast. The day was technically not a failure. The second stage of the Falcon 9 delivered its payload to the International Space Station on behalf of NASA. But everyone was far more interested in what happened afterward, with the “autonomous spaceport drone ship” landing, because of what it could mean for the space industry.

Today's launch systems drop spent stages into the sea, but SpaceX and other private space companies want to fly them down to Earth – or a barge on the ocean – and reuse them. SpaceX officials say this could drive launch costs from about R700 million down to R50 million, and thus change the way the world industrialises – and possibly colonises – space. “That will lead to space travel being just as easy and inexpensive as travelling from New York to London is today,” says James Pura, director of the Space Frontier Foundation.

SpaceX determined that the crash was caused by an inadequate supply of hydraulic fluid during the flight's last few minutes. The fluid powers fins that help steer and stabilise the rocket. Engineers set to work preparing to try again, possibly at a newly rented location at Cape Canaveral. Here's how the process will work.

150
KILOMETRES
HIGH

PAYLOAD →

80
KILOMETRES

1

1

LAUNCH AND STAGE SEPARATION

A two-stage Falcon 9 rocket rises from its launchpad, and at an altitude of 80 kilometres the first-stage booster separates. The payload continues into space, riding on the second stage. The first stage coasts to about 150 kilometres in altitude, then begins to descend.

2

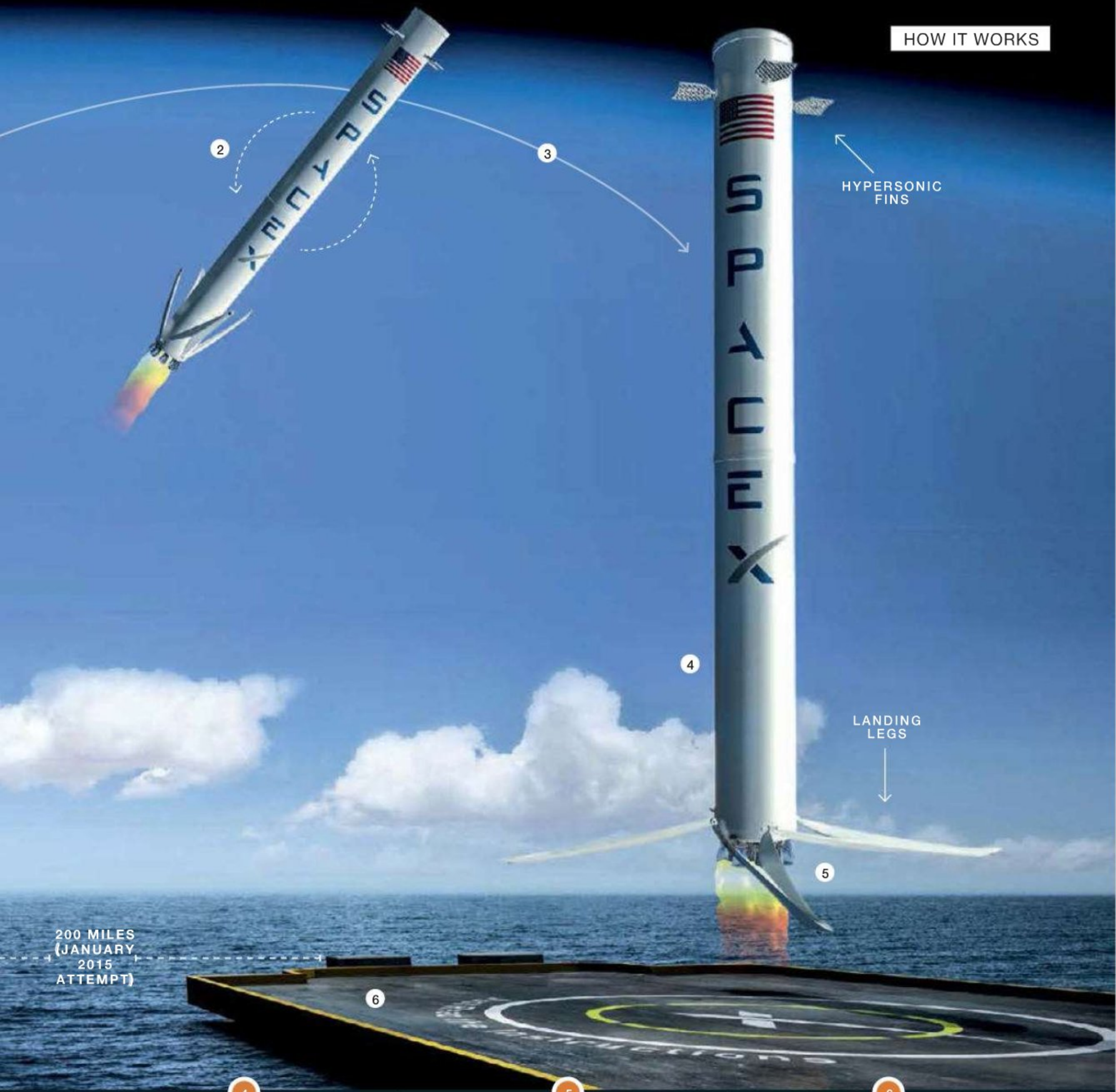
BOOST-BACK BURN

Three of nine engines from the first stage reignite. The rocket has its own guidance-control system, which gimbals (orients) the Merlin 1D engines to rotate the rocket between 120 and 180 degrees. This aims the rocket towards the drone ship. The booster is travelling at nearly 5 000 kilometres per hour.

3

SUPERSONIC RETRO-PROPULSION BURN

The centre engine ignites to slow the descent and gimbals itself to help the booster become fully vertical. Four grid fins extend to stabilise and further brake the cylinder. Each moves independently to control roll, pitch and yaw. The rocket's speed drops from 5 000 kilometres per hour to about 900.



200 MILES
(JANUARY
2015
ATTEMPT)

LANDING BURN

The engines initiate a final burn to slow the craft to about 8 kilometres per hour. Four carbon-fibre-and-aluminium-honeycomb landing legs unfold, powered by compressed helium.

TOUCHDOWN AND RECOVERY

The booster lands on the floating pad. Technicians on a vessel positioned kilometres away head over to board the drone ship and secure the rocket to the deck with metal shoes and vent any leftover gases. The drone ship ferries the first stage to shore, where it can be processed, cleaned and reused. Flight length: about nine minutes.

LOATING LANDING PAD

The drone ship is equipped with a dynamic positioning system that uses azimuth-thruster engines to keep it at a specific GPS point hundreds of kilometres (in the case of the January test, about 300 kilometres) away from the launchpad, give or take three metres.

HOW YOUR
WORLD WORKS

COOLSHACK

One man's collaboration with UCT aims to improve the lot of shack dwellers. BY SEAN WOODS

NEXT TIME YOU bitch about oppressive summer temperatures while scuttling between your climate-controlled vehicle, office and home, spare a thought for those living in tin shacks. To say the occupants swelter is an understatement. In fact, tests have shown that when ambient temperatures reach 36 degrees, temperatures inside conventional shacks soar to a staggering 47 degrees plus – making life pretty much untenable. Happily, a collaboration between electronic security expert Mark Algra and Dr Kevin Winter from the University of Cape Town's Environmental and Geographical Science Department aims to change all that.

The project – part of Cape Town's World Capital Design initiative – kicked off in November 2014 when Algra and Winter constructed two typical 2 x 2,5 metre shacks on UCT's grounds. One was left stock-standard as a control, while the other was clad with experimental materials and incorporated various adaptations to help bring internal temperatures and humidity levels down. Both were rigged with high-resolution monitoring sensors to capture temperature and humidity data every three minutes, allowing Winter's department to determine exactly how the materials and designs performed in real time.

Says Winter: "Our aim was to find simple ways of reducing the temperature in the experimental shack by 10 degrees



Mark Algra (left) and Dr Kevin Winter can be contacted on markalgra5@gmail.com and kevin.winter@uct.ac.za respectively.



Top: Two standard Cape-Flats shacks – one left stock-standard and the other incorporating various affordable low-tech adaptations – were set up on UCT's campus and rigged with high-resolution monitoring sensors to capture temperature and humidity data every three minutes. **Above right:** Dr Kevin Winter and Mark Algra experiment with fire retardant materials. **Middle:** Multiple adaptations, including an air cross-flow system were incorporated to achieve the desired results. **Right:** A basic plumbing system with an aerobic soakaway allows residents to dispose of greywater safely at night.

compared with the conventional shack, and at least 2 degrees below ambient temperatures using low-cost materials that were readily accessible."

Simply glueing fabric derived from recycled PET bottles to the outside and painting it with white PVA helped lower temperatures by 3 degrees. Adding a pitched roof brought another 3 degree reduction. They then cut two small holes at the base of one wall and placed two small containers with wet charcoal near them to suck cooler air into the shack. On the opposite side they cut a few holes in the ceiling and placed an inverted plastic basin fitted with a curved plate on top to create a venturi effect and suck hot air out. Says Algra: "Once we incorporated this cross-flow adaptation we immediately began achieving our desired temperatures – that's when we realised we were on the right track."

Other adaptations included smearing a paper cement mix on the inside walls to provide insulation in winter and remove the typical unhygienic cardboard cladding. Giving the pitched roof wide enough eaves to channel water away from the walls and on to a micro garden. Plumbing in a basin, allowing occupants to dispose of grey water into an aerobic soakaway at night. And fitting a "litres of light" bottle (that is, a 2-litre cooldrink bottle filled with water) to distribute light during the day.

Currently, Algra and Winter are busy experimenting with fire-retardant materials. They are also planning to retrofit 10 shacks to see how their improvements perform for families in the real world. Says Algra: "Ideally we would like to turn this initiative into jobs. If people want to climb in and develop what we've achieved further it would be great."



LG **SUPER** UHD TV

LG Electronics South Africa introduces a first-of-its-kind, Super Ultra HD TV that brings the entire colour spectrum to life, giving another dimension of colour in full 4K resolution.

With this innovative new technology, TV viewers everywhere can experience a whole new, vibrant dimension of colour with features like ColorPrime technology, ULTRA Luminance, a 4K In-Plane Switching (IPS) panel and a Prime Mastering Engine. What this does, is create greater image depth with picture-perfect realism – a new pinnacle pioneered by LG.

ULTRA Luminance technology continuously analyses the brightest and darkest parts of the displayed content in order to improve brightness and resolution. Equipped with LG's 4K IPS panel, the TV is able to render detailed images at extremely wide viewing angles. What's more, the Prime Mastering Engine optimises the TV's settings to boost picture quality to unprecedented and extraordinary levels.

LG's SUPER Ultra HD TV comes with the stunningly thin 8.5mm UltraSlim Design display, which easily blends itself into any living space with sleek perfection.

Now with a remarkable new user experience thanks to its WEB OS 2.0, the TV menu system has been streamlined to perfection. Essentially an upgraded version of LG's much lauded WebOS user interface, it was originally designed under the "Make TV Simple Again" concept, overcoming the growing frustration with unnecessarily complex TV menu systems.

LG's SUPER Ultra HD TV reinforces the LG brand and reinvigorates the TV watching experience, putting picture quality at the forefront. From sport to movies to drama, with LG's SUPER Ultra HD TV every colour comes alive.

These models and sizes have been exclusively launched in South Africa:

- * Model UF950T available in Size 55" & 65"
- * Model UG870T-Curved available in Size 55" & 65"
- * Model UF850T available in Size 55" & 65"

Go to www.LG.com/za for more information

NOW YOU KNOW: The real difference between IndyCar and Formula One is that IndyCars race primarily in the US and Formula One is global. It's like Premier League and Major League Soccer: same basic thing, different fanaticism. Also, only IndyCars race on oval tracks.

UNDER THE BONNET OF AN INDYCAR

INDYCAR ENGINES MUST WEIGH at least 112 kilograms, and the car at least 712. So that's exactly what teams aim for and not a gram more. We spoke with two of the men most responsible for the 2.2-litre twin-turbo-charged Chevy V6 that 2014 IndyCar Series champion Will Power will drive in the Indy 500 on 24 May: Chris Berube (IndyCar Series Chevrolet program manager) and Ron Ruzewski (technical director for Team Penske). They explained how they get 500 kilowatts from a car that's half the weight of a Mini Cooper S. BY KEVIN DUPZYK

1. STARTER

This is where it would be if IndyCars had starters. The pit crew uses an external electric motor to crank the engine. One downside: if the car stalls, the driver can't restart it.

2. EXHAUST

To reduce weight, IndyCars have short exhaust pipes, no catalytic converters and no silencers.

3. STRUCTURE

The engine is a component

of the chassis, with a load-bearing block and cam covers. It literally holds the car together. The gearbox and suspension bolt to the back of the engine, and the driver compartment bolts to the front.

4. FUEL INJECTION

Most fuel-injected cars use nozzles to spray fuel into intake ports outside the combustion chamber; some performance cars inject fuel straight into the chamber. To give Power's IndyCar the

massive amount of fuel it needs, his engine does both.

5. LUBRICATION

Traditional cars collect oil in the oil pan and pump it into the engine, but a race car moves fast enough that, with that set-up, the oil would slosh around, preventing it from reaching the pump. Instead, a dry-sump system pumps oil to a separate reservoir that keeps it constantly in reach.

6. PISTONS

The pistons are handmade to exacting, highly confidential specifications. Because racers look for every advantage they can get, Power's team can't share more.

7. COOLING

Scoops on the sides capture air to cool the engine. If the

car sits for much longer than the eight to ten seconds of an average pitstop, it can overheat.

ACCESSORIES

With so few accessories, there's no accessory drive-belt. Things such as oil pumps are powered directly by the engine.

LIFESPAN

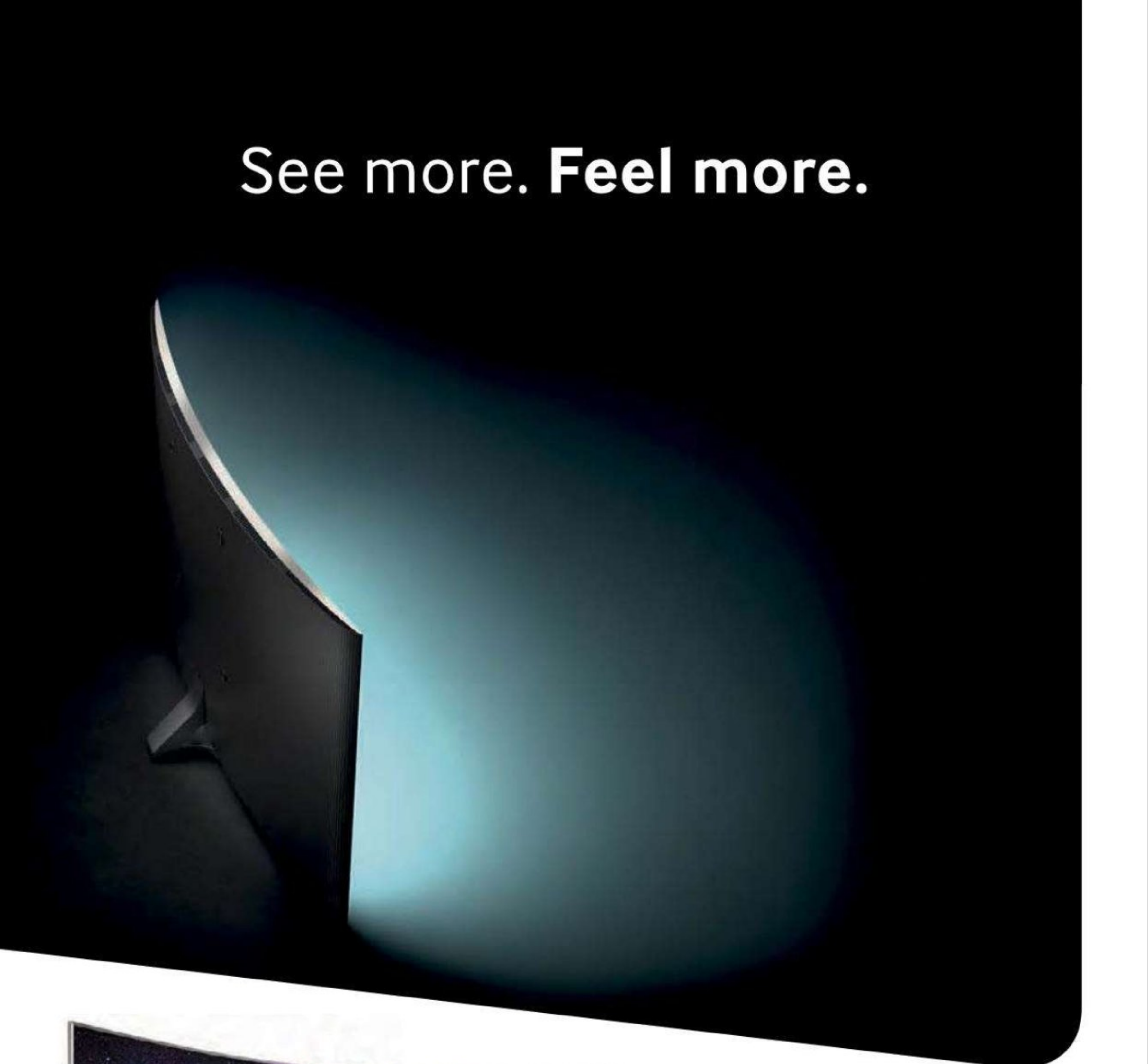
The league has stringent regulations on engine use. Drivers can go through a maximum of four engines per year. They can be replaced at 4 000 kilometres or if they will exceed 4 585 by the end of a race. A whole new engine before you'd even need an oil change.

PHOTOGRAPH BY BRYAN REGAN



BACK OF CAR ◀ FRONT OF CAR

See more. **Feel more.**

A curved black monitor is shown from a low angle, displaying a bright blue screen. The monitor is set against a dark background, and the blue light from the screen creates a soft glow. The text "See more. Feel more." is visible in the upper left corner of the image.

With more captivating colours, striking contrasts and revealing brights, the new Samsung SUHD TV is an addition to the Samsung Signature Series that will not only allow you to see more, but feel more as well.

UA65JS9000



SAMSUNG

THE REBIRTH OF HARD CIDER

Artisans and smaller regional operations are adding their own distinct flavour to a fruity favourite. This is your guide to enjoying it. BY FRANCINE MAROUKIAN

AT ITS CORE, HARD CIDER is an agricultural product, an alchemical alliance between the apple and the land where it grows, shaped by the maker's skill. Unlike beer, cider is not made from grain, so it does not require brewing. Made with fruit, like wine, it only ferments. And because it ferments, craft ciders – those made with local orchard apples – have terroir, or a regional fingerprint reflecting variables of climate, soil, terrain and tradition. Early apples, cultivated from European trees, were not meant for eating out of hand. They were “spitters”, bitter tannic apples intended for preservation, particularly in the form of fermented cider – the only safe, bacteria-free daily beverage at the time.

Because apples are heterozygotes, their seeds do not breed true: an apple that grows from a seed will be nothing like the apple it came from. Instead, stem grafting is typically used to reproduce apples. A budding apple-tree shoot is inserted into the stock of another tree already rooted in the soil.

That didn't stop the man who became known as Johnny Apple-seed. Early ecologist John Chapman travelled to the US west planting orchards with seeds collected from cider mills. As a member of the Swedenborgian Church, Chapman believed that stem grafting was unnatural, so he practised seed propagation, with each seed producing



THE EXPERT
Max Kuller, wine director, Doi Moi and Estadio restaurants, Washington, DC.



a different variety that adapted to regional conditions, making them distinctly different from Old World stock.

But, by the early nineteenth century, hard cider had lost its importance, a trend intensified by the temperance movement as farmers were pressured to clear their cider orchards in favour of growing the table apples we know today. Practical inventions also intervened. Sanitary waterworks and the bottle cap made new drinks such as Coca-Cola possible. The pasteurisation process, the milking machine, and the refrigerated railroad wagon made milk more readily available as well. In the USA specifically, cultural changes such as industrialisation and urbanisation also drew immigrants from other parts of Europe, including a significant German population who built breweries as the heart of their neighbourhoods. It was simply the end of the cider era.

FIVE MUST-TRY CRAFT CIDERS

THE CIDER

THE MAKER

EVERSON'S
6,0% alcohol

Grabouw,
Western
Cape



*by volume

Besides wine, the Eversons make what's described as a pale dry, natural apple cider that's a mix of 5 different apples, fermented with a French cider yeast and aged in oak. Also available on tap.

James Mitchell's Gone Fishing
5,8% alcohol

The Drift
organic farm,
Overberg,
Western Cape



► Based on a family recipe, this secret blend of apples is pressed in a restored Bucher press, gravity-settled and then cold fermented in a combination of oak barrels and small tanks and aged for six months.



Ezra Sherman, co-owner of Eve's Cidery in Van Etten, New York, samples freshly pressed apple juice from a traditional rack-and-cloth press.

Over the past several decades, renewed interest in America's agricultural heritage and heirloom pome fruits such as apples and pears have boosted the taste for hard cider. In South Africa, our agricultural heritage is unquestioned, but even here cider never reached the heights of popularity achieved by beer.

MAKE IT

THE BASICS OF MAKING HARD CIDER

There are endless variations, but, in general, the cider-making process follows this formula.



THE APPLES

Cider apples are divided into categories according to proportion of acidity and bitter-tasting tannins: sweet, bittersweet, sharp and bitter-sharp. First allowed to soften to develop flavours and increase sugars, cider apples are then washed, sorted and processed whole. Some are suited for single-varietal cider, mostly heirloom apples with the ideal ratio of tannins, acidity and sugar. Other ciders require blending apples to balance flavours. This blending, which can be done at any stage, is the maker's skill at work.



THE GRIND AND PRESS

The apples are milled or ground into a fine pulp called pomace, collected into sieves such as mesh envelopes or trays, and stacked in a press. The presses vary in construction, from historical hand- or horse-turned screw presses all the way to modern hydraulic versions. After the free-flowing juice is released, compression continues to extract juice until the pomace is dry. Traditionally, this dry pomace "cake" was steeped in water to make ciderkin, the low-alcohol cider that colonial children drank.



THE FERMENTATION

The juice is transferred to a container (often a double-jacket stainless-steel vat) and fermented with yeast (either occurring naturally from the tannins in the apple skins, or a cultivated strain, such as wine yeast) that converts the sugar into ethanol and carbon dioxide, which escapes via an air-lock on the fermentation container. The fermented liquid is then filtered – commercial cider is typically pasteurised – to remove yeast and apple particulates. Finally, it's transferred to the bottling stage, which varies from maker to maker.

A FEW NOTES ON TASTING

TASTE IT



The natural fruitiness of hard cider makes it a good partner for food that already marries well with apples, but it also enhances complex cuisine that skews pungent and spicy, such as many Thai dishes. Because cider is fermented from fruit, you can deductively taste it like wine. And like wine grapes, fermented cider apples give off the impression of a multitude of other fruits as well.



There's a line connecting the appearance and the aroma of the cider to how it will present itself on the palate. Not to say craft cider can't surprise you, but, usually, if you can smell it, you will taste it.



If the cider is clear, with the solids filtered out, expect a more elegant taste and a fresh, fruit-forward aroma with traces of citrus (lemon, grapefruit) or even more aromatic tropical fruits (pineapple).



If the cider is cloudy, with particulates left from minimal processing, expect a more rustic experience, trading dominant fresh fruit and floral notes for a funkier, earthier, yeastier, organic aroma.

Garagista Beer Company
Skunkworkx Double Barrel
8,0% alcohol

Riebeek-Kasteel



Garagista's Double Barrel won second place in the cider category at the South African National Craft Brewer Championship. Also available is pure apple and a pomegranate cider, both of them 5,5 %.

Red Stone Pure Fruit Ciders

4,5% alcohol
Clarens Brewery,
KwaZulu-Natal



Cider doesn't have to be made in traditional apple country: this one comes from the Free State's Maluti Mountains in the Free State, part of a range of fruit ciders that includes cherry and pineapple.

Windermere Premium
7,5% alcohol

Windermere Farm, Western Cape



When launched in 1998, Windermere initially had to go into hibernation through lack of demand. Fortunately, it's back to full-scale production with this authentic German-style *apfelwein* that's matured in French oak for six months.



Do you have unusual questions about the world and how it works and why stuff happens? This is the place to ask them. Don't be afraid. Nobody will laugh at you here. Email popularmechanics@ramsaymedia.co.za Questions will be selected based on quality or at our whim.



DO MAGNETS GO BAD? IF SO, HOW?

A MAGNETS DO GO BAD, USUALLY AS A RESULT OF CHILDHOOD ABUSE or deprivation. It's a sad state of affairs – but you can help. In return for your R500 donation, we'll send you this jaunty Save the Magnets beach bag.

But seriously, folks... magnets do lose their oomph. To understand why, let's look at what makes a magnet a magnet. Take any old piece of iron. Inside are particles known as magnetic domains. In their natural state, these particles are magnetically charged, but they're arrayed randomly, pulling in so many different directions at once that they effectively cancel each other out. Stick your iron in a strong magnetic field generated by something like a solenoid (an electrified coiled wire) and the magnetic domains will align and pull in the same direction. Now you've got yourself a magnet.

The thing is, this alignment forces the magnetic domains into a higher energy state, which (per the second law of thermodynamics) they don't like at all. Give them half an excuse (or, to use the scientific lingo, a catalyst) and they'll randomise themselves back into relaxation mode, just like the rest of us. One catalyst is simply time. Wait long enough and any magnet will fail. These days, though, long enough is a couple of hundred years, so this isn't a big worry. Another catalyst is heat. Heat a magnet sufficiently and it'll go back to plain old metal. Yet another threat is exposure to a more powerful magnetic field, which can yank the domains back out of alignment. Finally, there's shock. Drop a magnet repeatedly, or pound on it enough with a hammer, and you can jar the domains from their singular orientation. Delicate flowers, these magnets.

Does putting a piece of toilet paper on the seat do anything to protect you from germs?

You'd do just as well to burn a pile of sacrificial owl feathers or chant in Mycenaean Greek before mounting the commode. Or maybe you could slather your backside with a nice marine-grade wood varnish. Whatever makes you feel better. Any benefit

derived from a toilet seat swaddled in bum wad is strictly psychological.

Toilet paper is both porous and absorbent, two qualities that more or less guarantee any unseemly or infectious microbes lurking on the seat will find a ready vector straight to your skin. The good news is that your skin, unlike TP, is neither porous nor absorbent, and effectively keeps bacteria and viruses out of your body. Not that we're suggesting this (necessarily), but you could drop trou, settle down on a nice, comfy heap of *E. coli*, and watch the full director's cut of *Apocalypse Now* without becoming ill. That's because most of the bathroom-borne nasties we face – things that cause what we will delicately term gastrointestinal upset – enter our bodies through our mouths, which is why hand washing is so important. You touch, say, the flush handle, which happens to be contaminated, then bite your nails or toss back a handful of cocktail peanuts and you might as well stay in the can because, brother, you're going to need it.

If you're worried about herpes, or other sexually transmitted infections, you can also rest easy on the throne. Experts agree these are spread only through prolonged skin-to-skin contact, not butt-to-seat contact, and, in any event, can't survive very long outside human hosts. You should be fine.

Is there a reason for the dearth of quality toasters?

At last – a question of true import. As it happens, there are several reasons virtually all modern toasters are lousy, and we'll get to those. First, though, let's solve your problem. You want a brawny bread browner built for the long haul? Get yourself a vintage Toastmaster 1B14 and thank us between bites of crisp, buttered breakfast perfection.

The 1B14 is "absolutely hands down the best toaster", says Eric Murrell of the US Toaster Collectors Association (a real thing). More than 7 million 1B14s were manufactured between 1947 and 1961, aka the Golden Age of Toast. "They're easy to find, they're not usually that expensive, and the doggone things work," says Murrell, who, as the owner of more than 300 toasters, knows whereof he speaks.

So why can't modern toasters compete? Blame the consumer, whose demand for ever-cheaper appliances has led to ever-cheaper materials and manufacturing methods. Compounding the problem is that folks have come to accept today's feeble toasters as disposable commodities with all the soul of a plastic spork. The final issue is maintenance – specifically, nobody does any. If people bothered to dump the crumbs out every once in a while, their toasters might last a little longer. Not much longer, mind you, but a little. Take care of a 1B14, on the other hand, and you'll be set for decades. "My sister, she lives in Alaska," Murrell says. "She bought a secondhand 1B14 in 1969 and used it right up until, I think, about 2009." A used toaster that lasts forty years? In Alaska? What are you waiting for?

PM



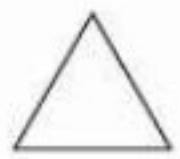
THERE'S METHOD TO OUR MADNESS.

Some say it's mad to create a car with up to 405kW. But we understand the sheer delight and exhilaration of immense power. We also understand the importance of mastering all that power. The F-TYPE is full of state-of-the-art technology such as Torque Vectoring and Electronic Active Differential that manage precise steering and power delivery for optimum performance. After all, with great power comes great responsibility.

JAGUAR.CO.ZA or visit your nearest dealer.



GREAT STUFF



YAMAHA MCR-B142 MICRO COMPONENT SYSTEM

Get your groove on

Just because you live or work in a confined space doesn't mean you can't appreciate quality sound derived from multiple sources. Yamaha's rather classy MCR-B142 Micro Component System (available in 10 funky colours) features Bluetooth music streaming, allowing you to enjoy your playlists wirelessly from your smartphone, tablet or other compatible device. It comes with a CD player, USB input for MP3 and WMA files, iPod/iPhone dock, AM/FM radio and auxiliary mini input socket. Even better, you can use your smart device to operate all playback functions from distances of up to 10 metres away.

Soundwise it doesn't disappoint, either. Yamaha's Compressed Music Enhancer restores the performance of compressed audio files. Its pair of 11,4 cm full-range cone woofers and its 15 watt output deliver a sound that's astonishing for a unit this size, with deep, robust bass and clear mids and highs (the speakers can be moved apart, too). Plus the unit's alarm can be controlled via your smart device, using Yamaha's DTA Controller app. Price: about R6 000. Contact Dion Wired on 0861 426 323 or visit www.dionwired.co.za





PEDEGO TRAIL TRACKER

Trailblazer

If there was a prize for the best off-road electric bike, Pedego's Trail Tracker would surely wear the crown. Designed for trails, sand and even snow, it features extra-large Innova Spider tyres, allowing you to go places most sane mountain bikers would fear to tread, erm pedal.

Its lightweight, removable 10 Ah 48V battery pack provides enough grunt to give the 600 W magnetic brushless

rear hub motor a comfortable range of between 30 and 40 km. Top speed is about 35 km/h (motor only). And the battery takes between three and four hours to charge.

Other features include Avid BB-7 front disc brake and Dia-Compe rear hub brake, handlebar-mounted battery indicator, variable twist throttle and light aluminium frame. Optional extras include a 3-speed upgrade (R4 000) and a customised military makeover (about R5 000). The standard bike will set you back a little under R37 000. Contact Pedego SA on 031-823 0770 or visit www.pedego.co.za



WD MY CLOUD EX4100 (FOUR-BAY) NAS ▲

Protect and store

Photographers, videographers, graphic designers and other creative professionals wanting to get a handle on their ever-increasing volumes of data (think RAW images and 4K video footage) should check out WD's four-bay My Cloud EX4100 NAS (Network Attached Storage) system. The WD Red drives can be configured using multiple Redundant Array of Independent Discs (RAID) options, including RAID 0, 1, 5, 10 JBOD and spanning modes. The system can also be configured to provide up to 24 TB of storage space.

Potential uses range from backups (Windows or Mac) or digital entertainment hub. Price: around R7 000 for a discless unit and about R30 000 for four drives, giving you a total of 24 TB. Visit www.wd.com



BLACK DIAMOND ION HEADLAMP ▲

Don't trip up

Black Diamond's touch-sensitive 80-lumen Ion headlamp switches from full power to dimmed, strobe or red light with the swipe of a finger. It burns up to 200 hours with a beam that stretches up to 38 metres, but weighs a mere 48 g, including two AAA batteries. Price: about R400. Contact RAM Mountaineering on 021-532 0549 or visit www.rammountain.co.za



LEAPFROG LEAPTV GAMING CONSOLE

Dance, learn, play

Harassed parents wondering how to keep their little ones occupied and stimulated this winter should check out LeapFrog's LeapTV Gaming Console. Suitable for children aged between 3 and 8, it encourages them to dance, jump and hop around while teaching them reading, maths, science and problem-solving skills. Audio instructions make it easy for pre-readers to follow along. Its simple interface allows young children to navigate menus by themselves. And the controller was ergonomically designed for little hands. The motion-sensing camera, specifically designed to respond to children's movements, allows them to see themselves in the game on TV. A library of over 100 age-appropriate, educator-approved games and videos (sold separately) will keep your little ones from getting bored. Price: about R1 800. Contact Toys R Us on 087 234 8697 or visit www.toysrus.co.za



CANON XC10 CAMCORDER

Moviemaker

Aspiring filmmakers wanting to up their game need to get their hands on Canon's new XC10 4K video and stills camcorder. Inheriting many of the Cinema EOS range's features, this compact shooter offers serious recording versatility, making it a great option as a stand-alone camera for independent filmmakers or a supporting B camera on larger productions.

Able to fit seamlessly into workflows, or productions with existing Cinema EOS cameras, it can record UHDTV standard (3840 x 2160) 4K footage to an internal CFast 2.0 card at up to 305 MB/s, or full HD (1920 x 1080) footage to an SD card at up to 50 MB/s. That's with pro-standard colour sampling for high-resolution performance.

Its specially developed 10x optical zoom (focal range: 27-270 mm) features Canon's trusted image stabilisation technology, allowing videographers to switch easily between sweeping scenes to intimate close-ups with a single lens. Other features include Wi-Fi connectivity, the ability to shoot 12 MP still photos, variable LCD touchscreen providing direct access to the menu and an included optical loupe viewfinder that fits the LCD to offer a more traditional filming experience. Price: about R26 000. Contact Canon on 011-251 2400 or visit www.canon.co.za



MADKON BRAAI ▲

Open and shut case

Looking for a convenient, well-built portable braai? If so, then the locally developed Madkon Braai (available in three sizes) could be of interest. Thanks to its ingenious folding design, setting it up from flatpack mode takes a mere two seconds. Packing it away again is only marginally slower at five seconds. Made out of 1,2 mm 3CR12 grade stainless steel, it's not only durable, but also lightweight and strong. All sizes come with carry bags and stainless steel grids. Prices range from the Mini (160 x 180 x 290 mm) at R2 300 up to the larger 600S (165 x 315 x 585 mm) for around R3 000. Contact Madkon on 084 254 8212 or visit www.madkon.co.za



INCREDISONIC FALCON ZERO F-360 HD ▲ DASHCAM

Capture the crunch

Recording the indisputable facts during an accident is a breeze with IncrediSonic's Falcon Zero F-360 HD rear-view-mirror-mounted car Dashcam. That's because this accident video recorder features two 720P resolution cameras. Both have a 120-degree viewing angle and can be independently rotated 180 degrees. Loop recording makes sure you never run out of space on your MicroSD card (it comes with a 32 GB high-speed Class 10 SD card). You also get night vision for interior clips and shots, as well as built-in microphone and speaker functionality. Oh, and it switches on automatically as you turn the ignition key. Price: about R5 700. Contact WantItAll on 087 357 5204 or visit www.wantitall.co.za



FLY6 CYCLING TAIL-LIGHT CAMERA ▲

Watch your rear

Cyclists need to keep tabs on what's going on behind them so they'll appreciate the Fly6. This nifty weatherproof device combines a 30 lumen LED tail-light with a HD camera and microphone, making it a great option for both the safety-conscious navigating busy roads or those hitting fast trails over weekends.

The 720 P camera shoots at 30 fps and has a sensor viewing angle of 100 degrees. Video footage (1280 x 720 resolution) is saved automatically on the included 8 GB microSD card, every ten minutes of your ride, in AVI format and date-stamped. The tail-light features four dimming settings (from high to off), as well as two flashing options and solid-on mode. Its rechargeable 2 600 mAh battery provides a runtime of up to 6 hours. Price: about R2 000. Contact the Cycle Factory on 021-552 8285 or visit www.cyclefactory.co.za



BOSCH RANGE FINDER GLM 100C ▲

Made to measure

Jotting down incorrect measurements or miscommunicating with fellow contractors are two ways to guarantee a building project goes pear-shaped fast. Fortunately, Bosch's Range Finder GLM 100C – along with its smart device app – helps avoid project-limiting mishaps.

This Bluetooth-enabled device boasts 10 measuring modes, including length, area, volume, angle and combined indirect height. Its built-in tilt sensor displays up to 360 degrees in two axes and features an accuracy of +/- 0,2 degrees. It also features a range of up to 100 metres, a backlit display with flip screen functionality (to make measuring in all directions easy) and an integrated rechargeable Li-Ion battery.

Already a great measuring tool, connected to a tablet or smartphone via its free app, the GLM 100C just gets better. Once you've photographed the work area using your device's camera, the GLM 100C then transfers all measurements to the photo using three types of graphic elements – lines, surfaces (rectangles) and angles. You can then add text and voice notes to the digital sketch before emailing in JPEG or PDF form. Price: about R3 200. Contact Boman Tools on 021-566 9408 or visit www.boman.co.za

MBAULA GREEN PORTABLE STOVE

Versatile, efficient cooker to go

Whether you're camping or forced to make an on-the-fly culinary plan during loadshedding, chances are you'd appreciate a hot meal. The compact, energy-efficient Mbaula Green portable stove lends itself to a variety of cooking method: pot, pan, even braai. Its robust, ceramic inner liner rapidly absorbs heat from the fire and helps maintain optimum temperatures, significantly reducing the amount of fuel required to get the job done. Speaking of fuel, it can burn any biomass, not only wood and charcoal. Temperatures can be regulated by adjusting the air ventilation door. It comes with two standard fittings, a stainless steel grill, stainless steel pot spacer and a carry bag. Price: about R600 for the galvanised version and around R1 000 for the stainless steel model. Contact Mbaula Green on 021-438 6003 or visit www.mbaula.co.za



COUGAR ARCHON CASE

Build your own beast

For hardcore gamers, few – if any – off-the-shelf computers will do. That said, if you're a serious gamer who wants to build his own machine from the ground up, then Cougar's new Archon case is for you. This mid-tower case comes with three 6,3 cm HDD/SSD trays and three 8,8 cm HDD trays. It also features easy-to-clean, detachable air filters on the front and bottom covers.

Once installed, the hard-working innards can be kept cool by up to five fans: one rear (pre-installed), two optional front side 120 mm fans, and two optional side 120 mm fans. Seven PCI vented slots provide flexibility and ventilation to suit multiple graphic card solutions. It can accommodate up to eight drives or drive bay accessories. To keep everything nice and neat, cables are fed through on the motherboard tray, allowing for easy routing and cable management. Price: about R500. Visit www.rebeltech.co.za


 Editor's choice

DJI INSPIRE 1 (WITH 1 REMOTE)

4K eye in the sky

When a class act like DJI brings out a new drone it always pays to check it out. The Inspire 1 doesn't disappoint. Weighing almost 3 kg, it has a maximum speed of just under 80 km/h, a controllable range of 2 km and a flight time of around 18 minutes. It can also hit an altitude of 4 500 metres, giving you the chance to capture some amazing footage. And, to prevent spinning propellers from getting in the way of the camera, the two arms supporting the four motors and landing gear lift out of the way after take-off.

A downward-facing camera keeps track of the ground,

allowing you to fly indoors and still achieve stable positioning when flying in difficult conditions with a compromised GPS signal. Ultrasonic ground proximity sensors tell the drone when to lower its landing gear and an intelligent battery management system automatically determines when it needs to head home for a recharge.

The camera, incorporating a Sony CMOS EXMOR sensor, features a nine-element lens and is mounted on a 3-axis, 360-degree rotating gimbal. The end result: really cool 4K video footage at 30 fps and quality 12 MP stills. Price: about R49 000. Contact Action Gear on 011-781 1323 or visit www.actiongear.co.za

PM



The powerful 3-in-1 tool

The cordless rotary hammer UNEO, drill and drive screws into any surface – wood, plaster, brick, and even concrete.

*Sold as tool only, batteries and charger sold separately. Part of the 18V System Tools family.



Make it your home. Drilling in concrete and masonry is especially easy and comfortable with the cordless rotary hammer: equipped with an integrated electropneumatic hammer mechanism, the Bosch UNEO is not reliant on the user applying feed pressure. With its powerful lithium-ion battery, the cordless rotary hammer makes it easy for you everywhere. The UNEO is part of the 18V system tools and the batteries & charger are interchangeable with all models that feature the Power4All



BOSCH
Invented for life



1

2

WE FEEL THE BEATING
HEART OF THE LOCAL MAKER
MOVEMENT AND MEET THE
PEOPLE AT THE BLEEDING EDGE
OF GARAGE ENGINEERING.



SOUTH AFRICA: MAKER NATION

I USUALLY SHY AWAY FROM INDIA PALE ALE because, you know, the *smell*. But the room-temperature one I'm holding right now isn't that bad; it smacks more of hops than the acidic-metallic urine notes I usually associate with an IPA. Maybe it's a combination of the crisp late autumn suburban Centurion air and the whiff of solder drifting outside from the 80s-style family home. It's a Tuesday night in Pretoria and I'm at House4Hack, the centre of South Africa's maker universe.

You may think it bold, calling this prosaic space in Lyttleton Manor the centre of any kind of universe. But a quick roll-call of the projects that have been spawned by these Tuesday-evening meetings of minds lists Robobeast, Reprap Morgan and Hans Fouche's Cheetah in attendance. All three locally made 3D printers started here. That's a stat no other maker space in the country can boast. And they also make palatable IPA.



BY LINDSEY SCHUTTERS

YOU DON'T BRING PROBLEMS TO THE HOUSE, YOU BRING PROTOTYPES. Something to show that you at least tried to solve your problem. Now you can draw from a 300-strong hive mind and learn new skills. That's the real beauty of these maker spaces. There isn't really any formal training to become a maker, so you learn by making (and sometimes breaking). All you need is an inquisitive mind, really.

Schalk Heunis is the godfather of the house, which he sees as an incubator for technology



3 1. Arnold and Phillip are the drone specialists at House4Hack and build almost everything from scratch. 2. Charlton Davids owns Segulla Electric, the sole manufacturers of the RoboBeast 3D printer. Factory capacity tops out at around 20 units per week. 3. House4Hack is a place for collaboration and skills transfer, a kind of open source classroom.



4 Omar-Pierre Soubra pitches the Cape Maker Faire to some of the members of House4Hack. **5** Quentin Harley is finally ready to take orders for his RepRap Morgan 3D printer. **6** Schalk Heunis owns the title deed to the house and is the godfather of this network of enterprising backyard inventors.

companies. "It all started with a 3D printer," he recalls. "Now, when they first came out we were very intrigued and got one. It took us about a month to assemble it, because there weren't clear instructions. One of the parts would break if you tightened it too much and the kit actually came with spares. Tightening it to breaking point was part of the instructions."

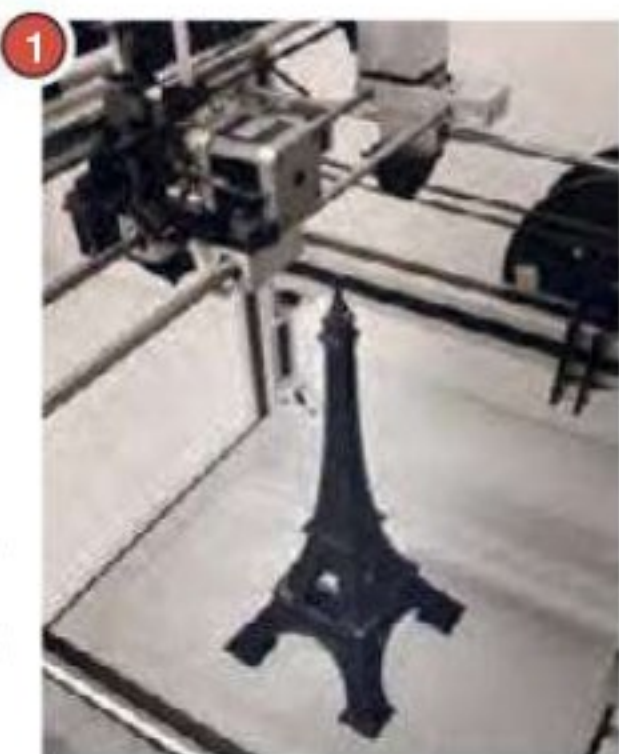
Before the dawning of the 3D printer, the house was a place to tinker with existing electronics. Then came the explosion. "Pieter van der

Walt came past here and said he'd heard of a thing called a Printrbot and he wanted to print a Printrbot," explains Heunis. "Everyone was looking at me to tell him he was mad." Heunis's response: "Whatever, dude, go for it."

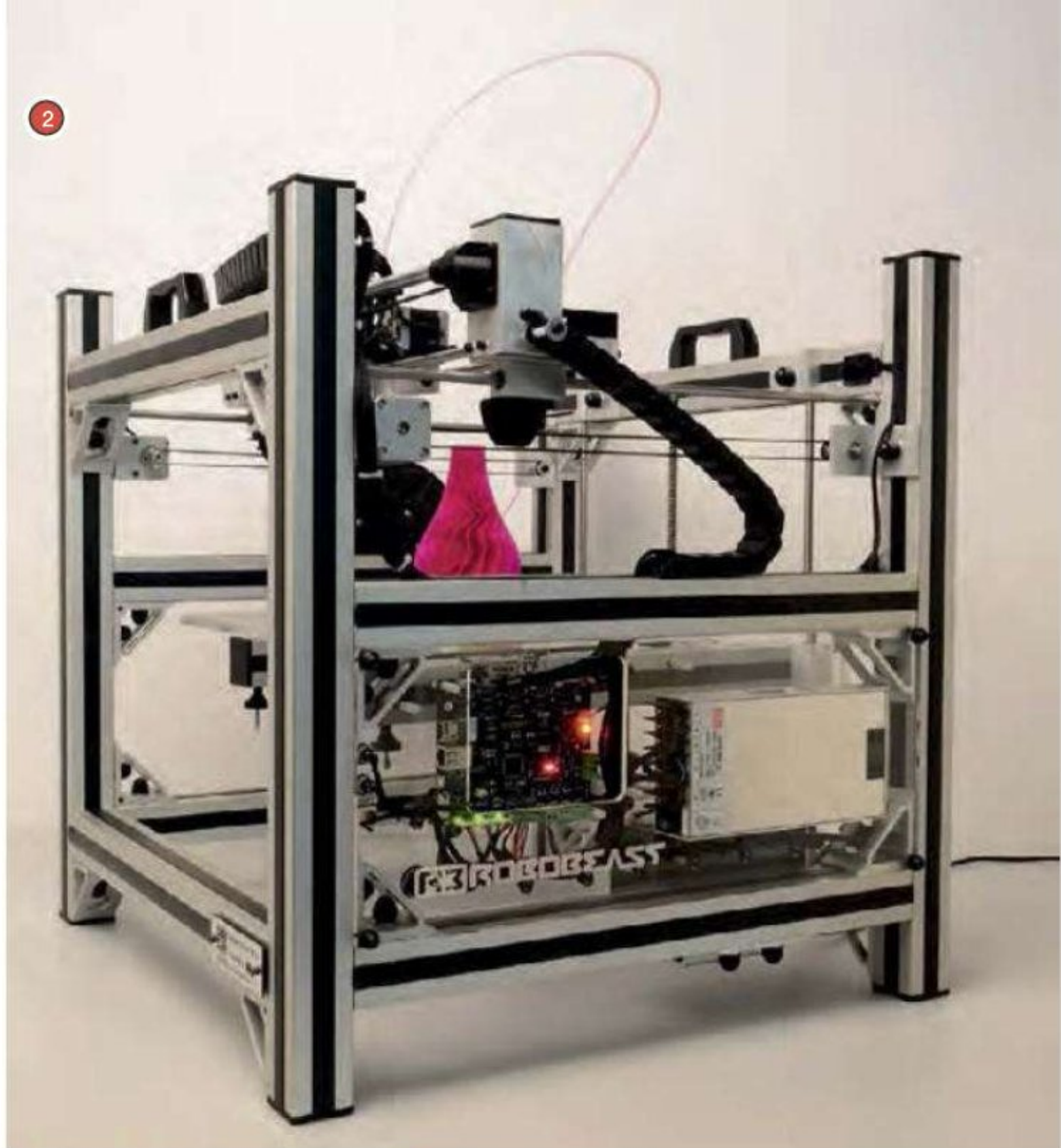
He went for it. A few weeks later, he had printed his own Printrbot and evangelised House4Hack to the dark art of RepRap (replicating rapid prototyping). (I have a problem with the term "RepRap". It should actually be "SeRepRap" because the core of the project/movement is printing components to make more printers; so it's mostly a self-replicating machine. At least that's the way three house members have used it.)

Whereas fellow house members Hans Fouche and Richard van As have gone with conventional cubic designs for their respective Cheetah and RoboBeast 3D

1. The maker movement revolves around the rapid prototyping talents of the 3D printer. **2.** Richard van As' RoboBeast is possibly the biggest success story to come out of House4Hack. **3.** RoboBeast stays true to the RepRap philosophy with all the plastic parts printed on another RoboBeast.



2



3



4. The RepRap Morgan has morphed from spare parts to precision machining. **5.** Quentin Harley, maker of the RepRap Morgan, helped develop the RoboBeast. **6.** While RoboBeast sells mainly to engineering firms, Morgan is meant for the home and small business.



6



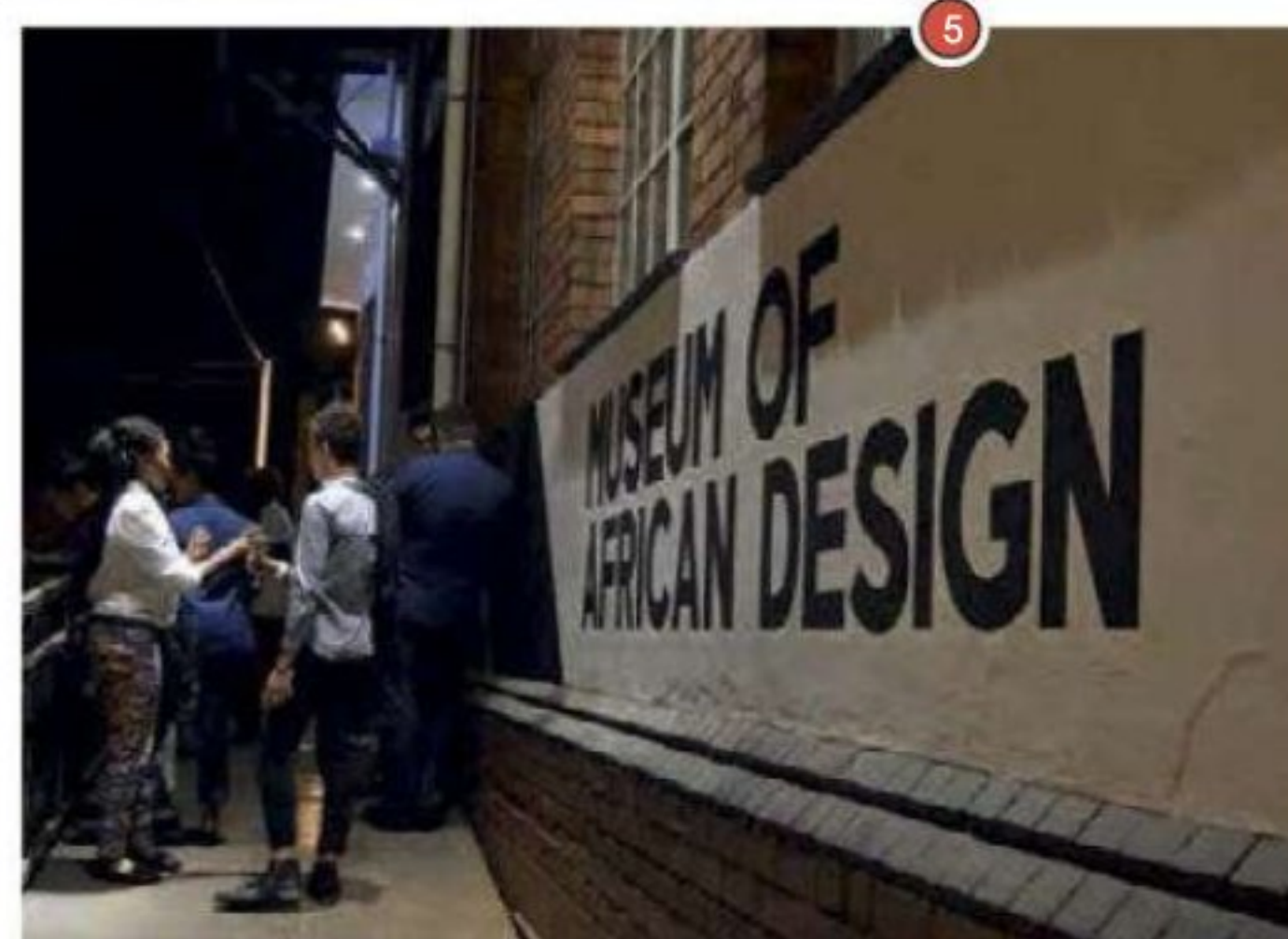
printers, Quentin Harley has a RepRap Morgan that looks like a piece of modern art. All RepRap machines are named after science superheroes, by the way; the Morgan is named after Nobel laureate biologist Thomas Hunt Morgan. Professor Morgan's greatest work was observing the unusual-looking offspring of two regular fruit flies. The namesake machine is intended to make more unusual printers.

Fittingly, the newly launched Maker Library at the Museum Of African Design (MOAD) has ordered a Morgan. I'm told it was more of a cost-based decision than an aesthetic one. MOAD's maker library librarian (yes, it's an actual title) and education director Batya Raff has been hard at work bringing the de facto tool of the makers to her carefully curated space. "We're not a white-wall, red-tape, stuck-up museum," says Raff about MOAD – which is ironically nothing but bare, white

walls as the museum prepares for a new exhibition and the launch of its maker library.

THE ROAD TO MOAD if you're travelling from OR Tambo airport takes you past bustling market (Bruma Lake) and cultural importance (Coca-Cola Park via the Albertina Sisulu freeway). I counted five schools en route to Joburg's Jeppestown. The museum is in the heart of the cosmopolitan Maboneng Precinct, so the space is at an intersection of hipster craft and education-

1. The Basotho Heritage Blanket-inspired clothing and accessories by Aranda is decadent in its Africaness. **2.** Museum of African design's vernissage was well attended and received. **3.** Batya Raff, herself a ceramic maker, is the librarian at MOAD's Maker Library. **4.** Clothing and textiles are possibly the oldest of maker mediums. **5.** MOAD is situated in Joburg's Maboneng precinct and attracts patrons from all cultures and walks of life.



al tools, fertile ground for cross-cultural collaboration and skills transfer. "It's a place of connection," explains Raff. "A place that draws in people who wouldn't ordinarily come into the Joburg CBD and a place where you can experience design and art in a different way. We're trying to show high African design and high African art as well as explore what it means to be in that making space and experiencing the process of making."

On opening night, the white walls are dotted with high-quality photography depicting uniquely African street scenes. There are two projector screens playing videos of girls getting their hair and make-up done in a nondescript African township. I'm tempted to buy a jacket made from a Basotho heritage blanket from their exhibition and to get drunk on the bespoke Bos Ice Tea cocktails. I bump into Raff in the Black Bottle whisky bar; it's conveniently located in the basement about five metres from the Maker Library, which has morphed into an interactive space where guests can build geometric shapes out of laser-cut pieces from a Trispace maker kit. It's all a bit high art and even higher fashion, but then I realise that artists and fashion designers are also makers.

"We're not following the tech shop model with big machines and electronics," she explains. "Whether it's woodworking tools or a 3D printer, we're equipping the space with tools that will help us bring these exhibitions to life."

It seems a world away from the beer and pizza-fuelled buzz at House4Hack, but the tights-sporting men and high-waisted ladies at the MOAD event are here for the exact same reasons: to be inspired and collaborate. If you think about it, Arduino control boards and Raspberry Pis are the same as sewing machines and cameras when used by skilled creatives in the way that the products perform a function and were made by people.

BACK AT THE HOUSE, Arnold and Philip give me a tour of their custom-built drones and show off a glider that took a snap of the Earth's curvature from 32 km up. They rapid prototype on a hot wire CNC machine that they built themselves. Arnold is the only guy in the house who uses Windows and this is proving

GREATEST HITS

South Africa has a proud maker heritage. Here are some of our finest moments

Statscan

The technologically advanced X-ray system is so amazing it was even included as a character on *Grey's Anatomy*. The ability to do a full body scan in around 13 seconds has revolutionised trauma units around the world and saved countless lives.

Bumbo

Oprah put this product on the map – and rightly so. It's a brilliantly simple way to prop your baby up so he or she can have a better view of the world. Aside from some *special* parents who leave their kids unattended on top of tables and want to use the Bumbo as a car seat, this product has received high international praise.

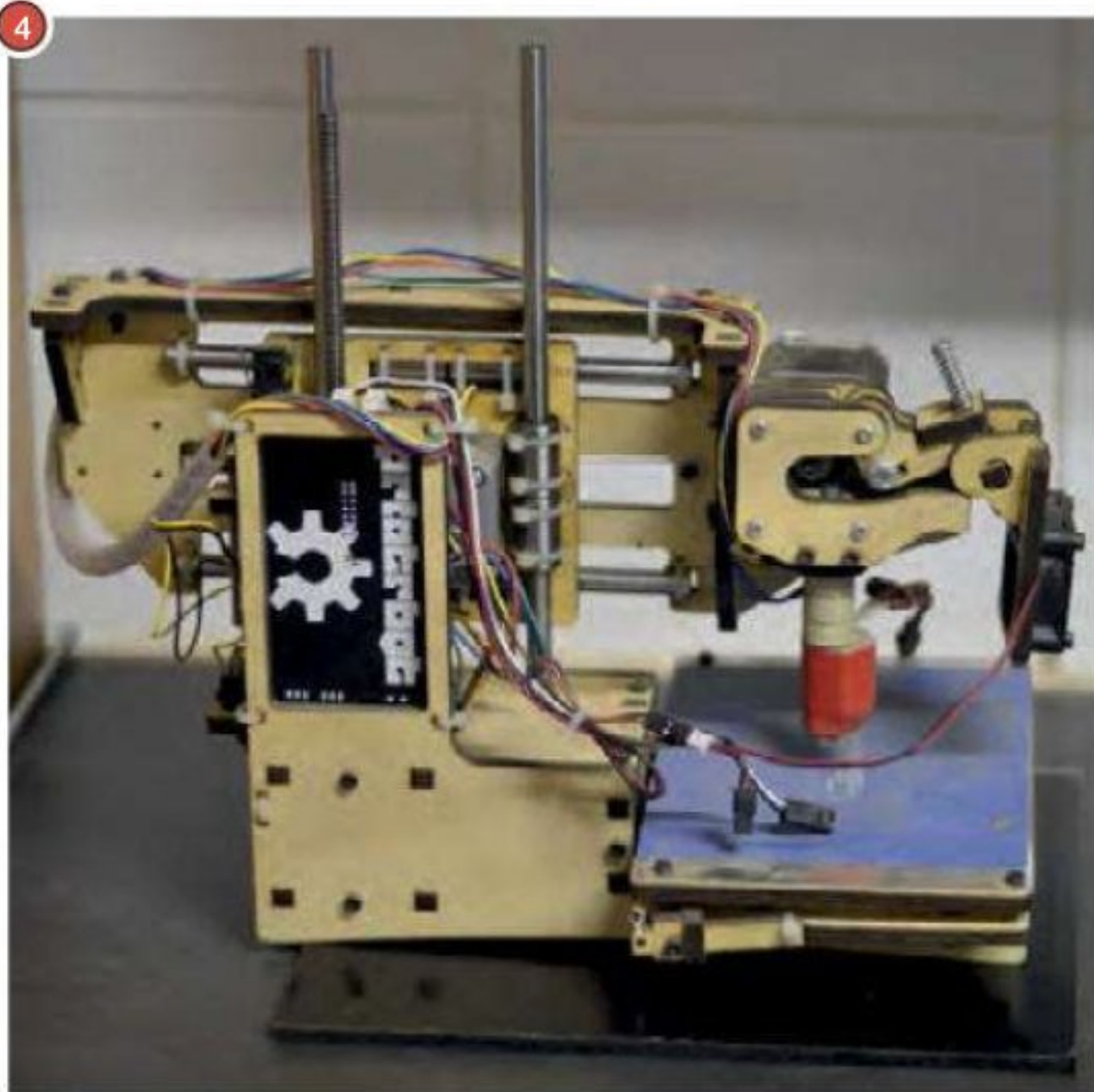
Dolos breakwater block

An elegant and effective way to protect against water turbulence – and often left off lists such as this because of the ubiquity of application. You find them everywhere in the world, but they were designed right here in SA in the 1960s.



1. Many of the maker projects revolve around the Arduino control board, but the South African-produced Speedy board is a hot favourite at House4Hack. **2.** The glider that flew up 32 km in the air and photographed the curvature of the Earth. **3.** Linux is the OS of choice for SA's open source-loving makers.

4. The infamous PrintBot was the first 3D printer printed by another 3D printer at the house. **5.** The Replicator printed the first pieces for the RoboBeast and the RepRap Morgan and was the primary 3D printer at House4Hack for many years.



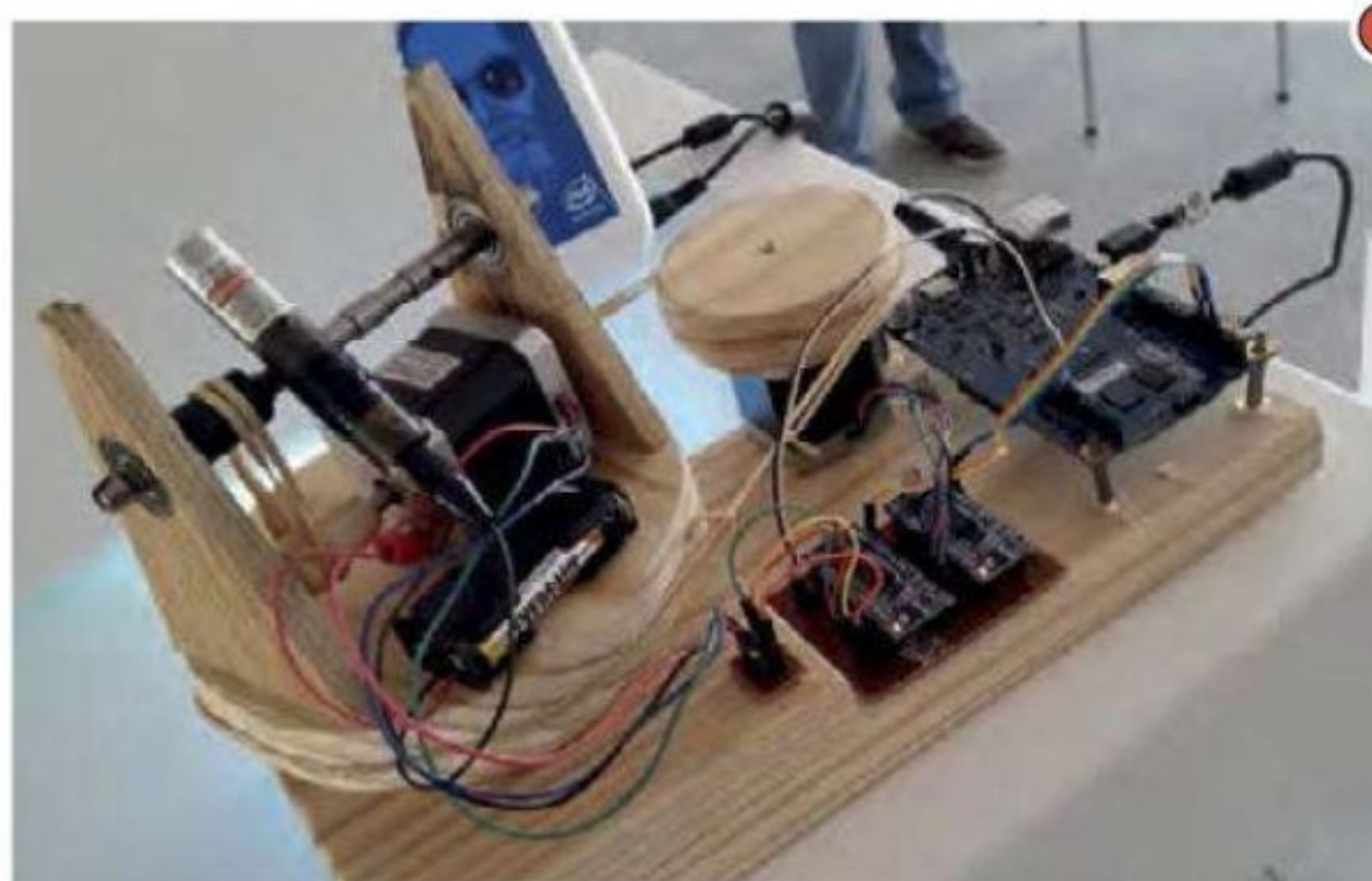
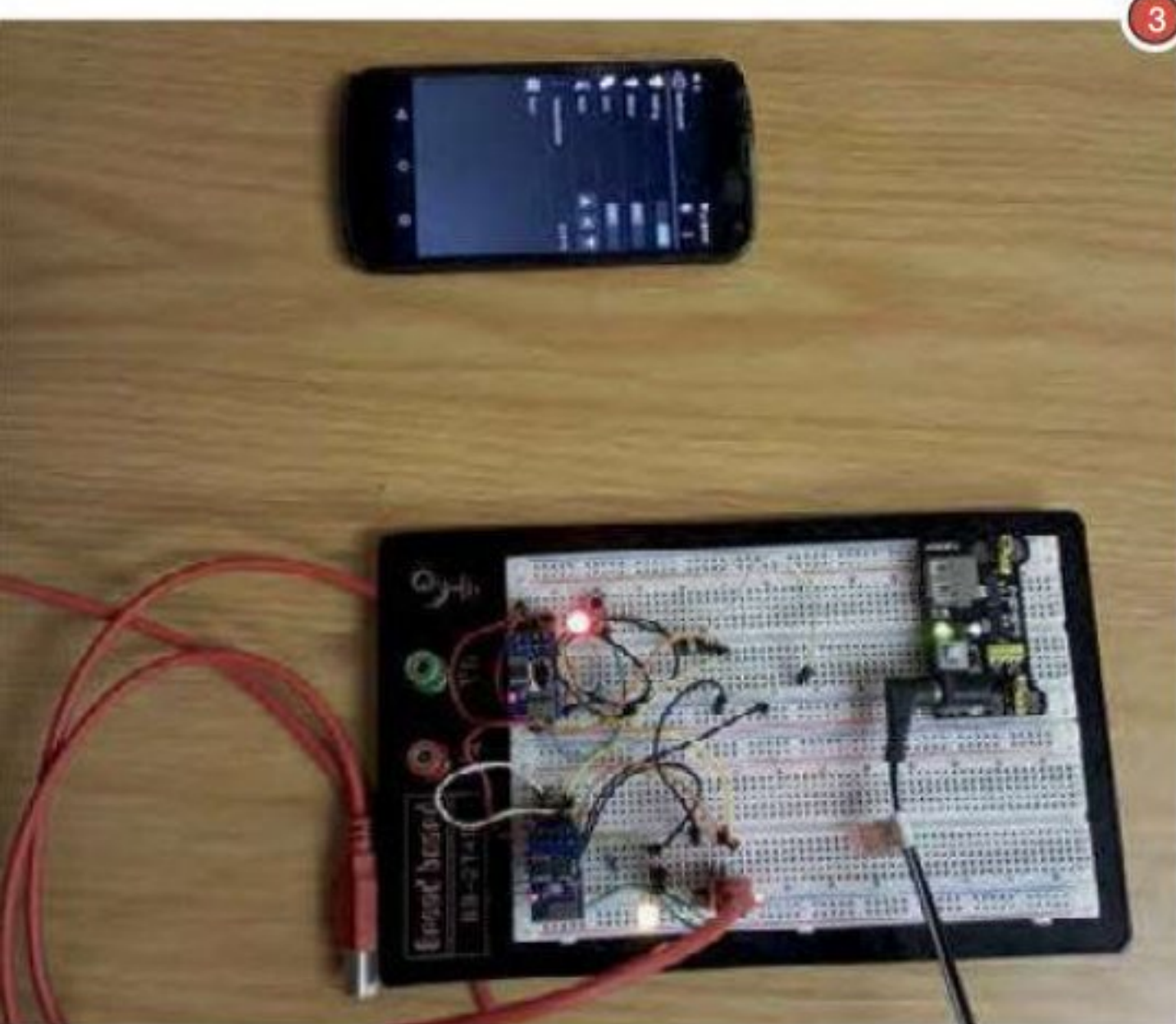
problematic. The laptop isn't communicating with the 3D printer very well and everyone he asks for help uses Linux.

I move over to find Org tinkering with a couple of lights on a PC board. He tells me that the lights are modules that connect to the smart home system he is busy developing. The red light is supposed to be the geyser; you can switch it on and off, and monitor the temperature using a smartphone app. I ask him if he has used the ZigBee smart plug/switch with the Altech Node. He says No and explains the philosophy behind tinkering. I think I've offended him.

There's an almost naïve charm to the excitement around each project I encounter. You can buy similar products off the shelf, but these guys are pouring their hearts into making it their way. And each one has a business plan. Some have even abandoned successful careers to turn their tinkering into commerce. I want to back each and every one of them, but I can't seem to shake the feeling of dotcom déjà vu whenever I hear about one of the start-ups.

The variety and levels of skills among the guys attending tonight's House4Hack

meeting is truly astonishing. There are only about 12 here now, but Schalk says the membership stretches to 300. They're mostly doing these projects in their spare time; most have day jobs and families. The group tell me about a 12-year-old member who built a robot that is intelligent enough to identify the colour blue and how they collaborated with another maker community to build fire-spewing projects for AfrikaBurn. My mind is blown and I want to go home and tell the world about South Africa's maker movement.



1. Org is the common model of a modern maker who tinkers in his spare time. **2.** A Raspberry Pi does duty as a Wi-Fi router. **3.** A small-scale smart home that you can control from your phone. **4.** Intel is trying hard to lure makers on to its Galileo platform through its developer zone network. **5.** This contraption will point out any star you ask it to and was developed by UCT students in 10 days using Intel's Galileo board.

IT'S AN IMPORTANT NIGHT because Omar-Pierre Soubra from Trimble is pitching his Maker Faire idea to House4Hack. Maker Faire is happening in Cape Town in August and will showcase South Africa's making chops on the Grand Parade. The house is skeptical because they were burnt at 2014's Maker Faire Africa in Joburg, which turned into an arts and craft show rather than a celebration of backyard engineering. Schalk wants a trade show where house members can exhibit their start-ups to a wider audience. The concerns are valid, but the South African public still needs to be made aware of what making is before they will invest in the products. The house is excited and speaks of an extensive mailing list that blankets our country's entire network of makers.

We have about 56 active maker spaces in our borders. The projects that come out of these hubs are as diverse as there are stars in the sky.

At an Intel event, I met three UCT students who developed the software and hardware for a device that will point out in the sky, using a laser pointer, any star or constellation that you ask it to. They built it in 10 days, the same time it took for a group from Tuks to build a radio-controlled car with a camera that will point any way you want to look.

On a larger scale you have RoboBeast, the robust 3D printer you can use upside down or in the back of a car. The inventor/designer Richard van As founded House4Hack with Schalk Heunis, and Quentin Harley was on the RoboBeast development team. RoboBeast manufactures in Roodepoort; all the components except the stepper motors and battery pack are locally made. Charlton Davids owns the company that builds the RoboBeast. You can call him a maker, too.

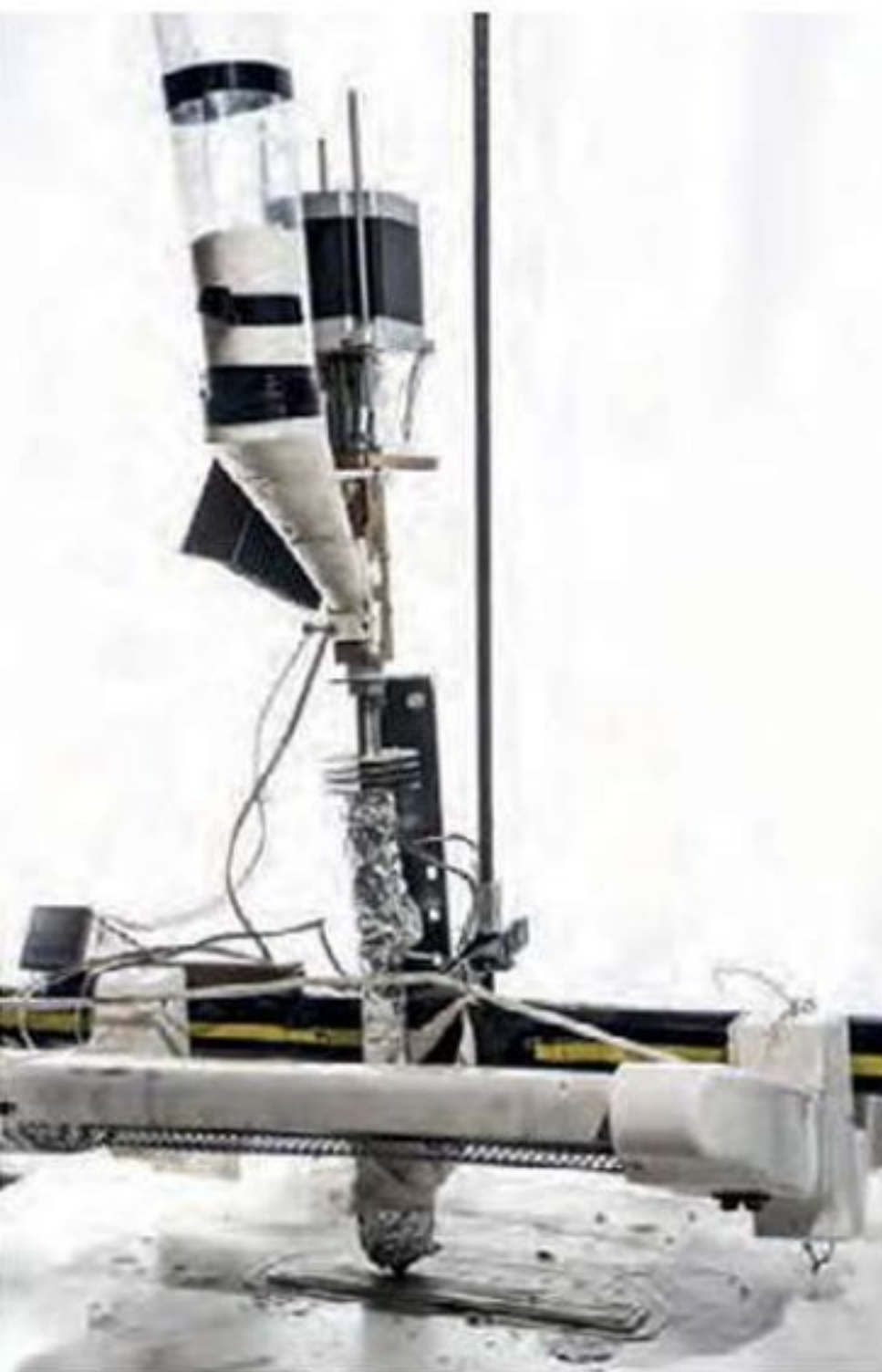
If you make something you're a maker. Since we're all making a better country together, South Africa really is a nation of makers.



CALL IT MADNESS OR GENIUS, BUT HANS FOUCHE IS COMPELLED BY A DEEP DESIRE TO CHANGE THE WORLD AND LEAVE HIS MARK IN WHATEVER WAY POSSIBLE.

THE KING OF THE MAKERS

BY LINDSEY SCHUTTERS



Hans Fouche has done a lot of making in his life, but his two most renowned inventions are the Cheetah 3D Printer that prints with ABS pellets – and the missile deployment systems for the Rooivalk.

IT DOESN'T TAKE LONG TO SEE WHY there isn't a line forming round the outside of Hans Fouche's Kempton Park property or why his inbox hasn't exploded with buyers clamouring for his home-baked Cheetah 3D printer. The machine, like its inventor, isn't what you can call refined. And if you were spending R100 000 on an industrial 3D printer, you'd be within your rights to expect better finishing and at least a housing for the control boards.

Still, though it may not look like it, the Cheetah has come a long way. It launched Fouche 3D Printing on the road to international notoriety. Actually, that's a bit of a fib: Fouche has many admirers around the globe. And most of them will know that Fouche 3D Printing started with chocolate.

"Do you know the term 'Chocnology?'" an animated Fouche explains. "If you Google it, you'll find an event that was hosted at MOAD (Museum of African Design). I 3D-printed chocolates for the Chocnology thing." That "thing" was a Nestlé event that invited artists to design chocolate sculptures to celebrate the launch of Android 4.4, also known as Kitkat. But how Fouche came to be a specialist in chocolate 3D printing starts with a tale involving the Rooivalk attack helicopter and Formula 1 race cars.

"Many years ago I was a mechanical engineer working at Kentron (now Denel) doing launchers for the Rooivalk attack helicopter's anti-tank missiles," explains Fouche. "I got to the age of 30 and something happened in my mind. I wanted to see my career ahead of me and couldn't see that at Kentron. I took my December thirteenth cheque and jumped on a plane to the UK with a pack of 15 CVs to hand in at all the F1 racing car teams. The story was, at least I had aircraft manufacturing experience, which is very similar to racing cars."

Eric Broadley of Lola Cars eventually gave Fouche his break with a three-month contract. Admittedly, that was at a much reduced salary than he was earning in South Africa, mostly because Broadley couldn't verify the contents

of his CV – a problem I found with this story, too. Fouche grabbed the opportunity, returned home to sell everything he owned and reported for duty at Lola. "When I arrived there was an opening at the Formula 1 team at Lola," he says. "I said, thank you very much, because F1 is my great passion. When I was growing up in Kempton Park I used to cycle to Kyalami to watch the races. There wasn't a meeting at Kyalami that I missed."

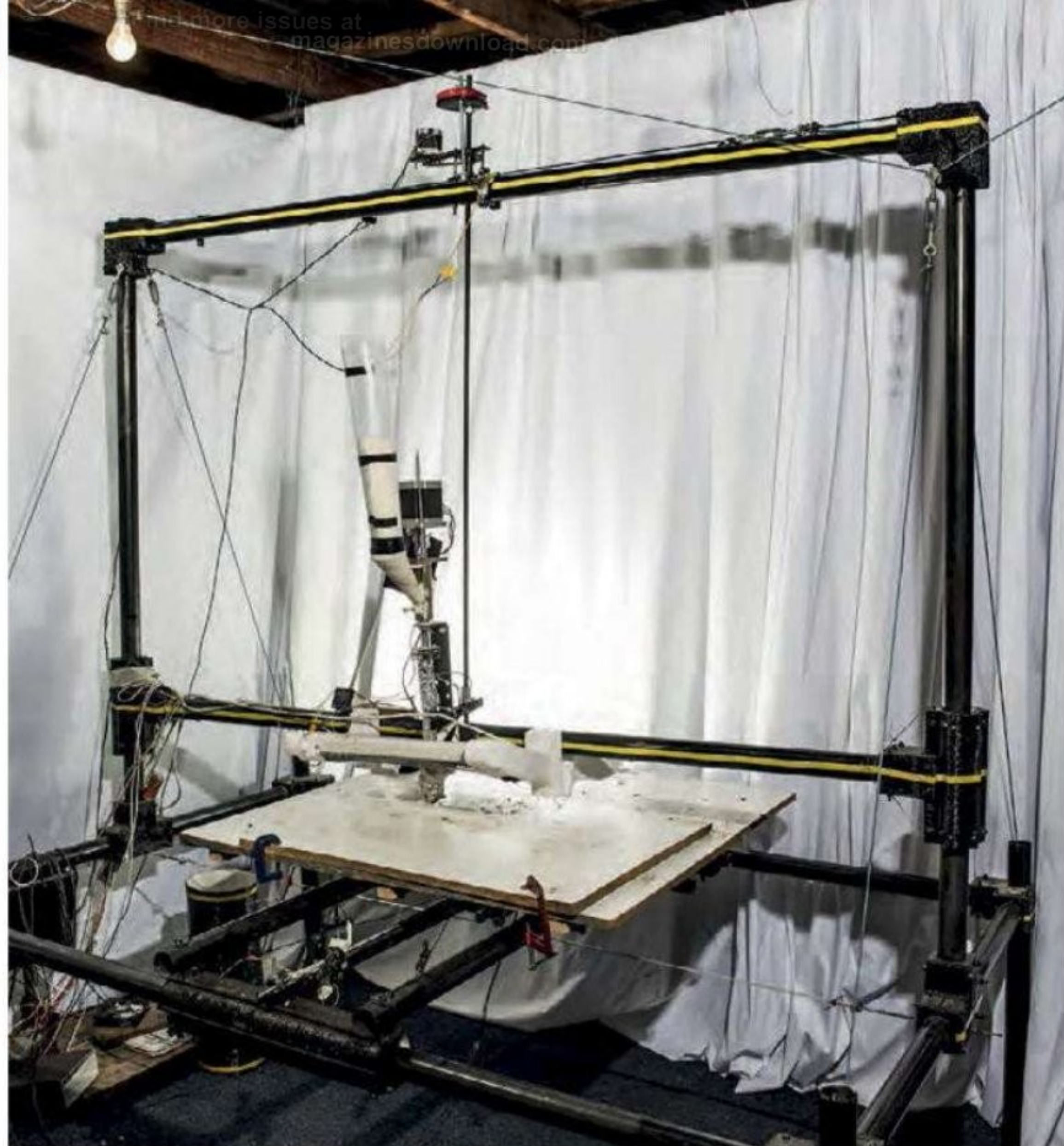
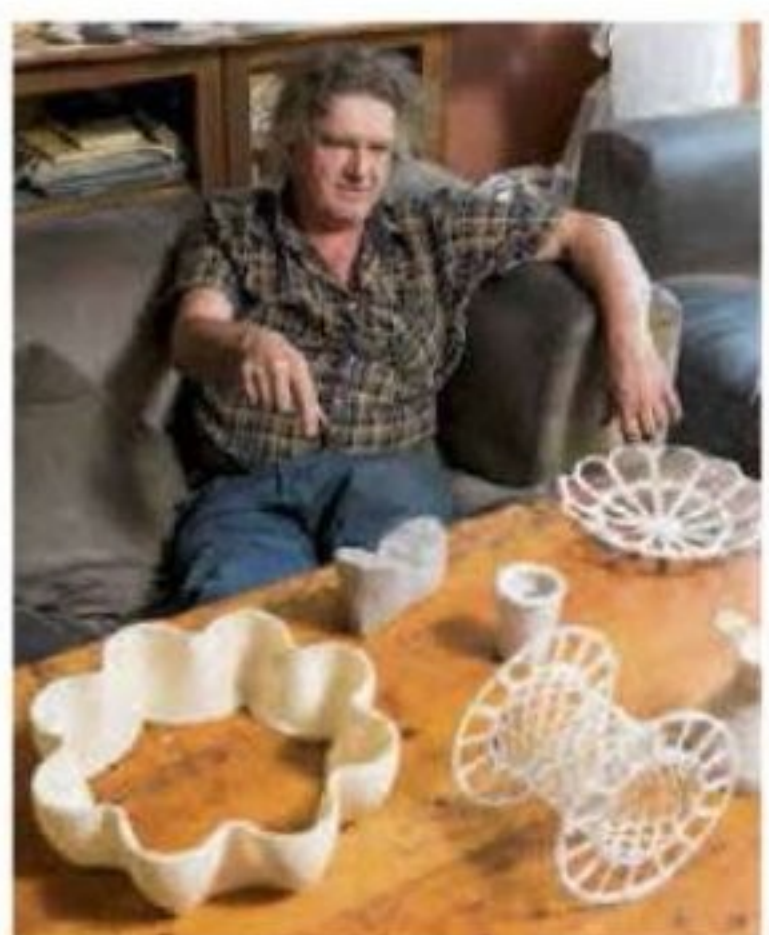
Throughout his tenure at Kentron, Fouche was a dedicated reader of international car magazines and it was in the pages of those magazines that he found his dreams come to life. He never says he was unhappy at Kentron; he rather recalls the frustration of the pace of development. There's nothing slow about race car development because, even over the course of a race season, engineers are refining and evolving the car design.

His first day at Lola was quite chaotic. "In SA, I was a senior engineer and had two guys under me. I was a boss," he recalls. "Draughtsmen do the drawing work here, but there engineers do it. I had to run off to the stationery shop to get rulers and pens. In SA, I was already working on CAD and had little experience working on a drawing board, but luckily the design process is the same for both."

From Lola Fouche moved to Leyton House, eventually ending up at Brabham as the chief aerodynamicist. Wikipedia lists him on the design team for the BT59 Formula One car and he was also involved in the abysmal BT60, Brabham's last race car, best remembered for a last place at the 1992 South African Grand Prix – our first post-isolation race. But it was at Brabham that Fouche started playing in the world of rapid prototyping.

"When you make a race car nose you actually build about 20 and you test it in the wind tunnel," he explains. "You then take the two or three best-performing models and take them a step further. And you do that with the wings, side pods, everything. In those years it was either NC

PHOTOGRAPHS BY
WALDO SWIEGERS



Proof of concept for ABS as a printing medium and the Cheetah as an industrial machine was the first project, printing a lawnmower which Fouche uses to cut his grass to this day.

(numerical control) cutting or you carve it out of wood. The more models you could make, the better your work was gonna be."

It was then that an idea sparked to build a machine that could form the models quickly from CAD designs. "I took a plotter, replaced the pen with a modified superglue tube with compressed air behind. You do the first layer with superglue, then spray it with an activator so that it immediately sets and then lift it one millimetre to do the next layer." He did all this in his spare time, so there's no official record of his ground-breaking innovation. Brabham also closed its doors nine races into the 1992 season, so his invention couldn't be proven through performances either.

When Hans returned home he got a gig designing rubbish trucks, but was trying to convince his friends at the CSIR to start designing F1 cars. His argument gained traction and a team pooled from SA's world-leading engineering companies (Atlas, Aerotek and Kentron) got to work. The project started brightly with the CSIR wind tunnels at Aerotek providing the perfect home base for development. Fouche installed a rolling road in the wind tunnel so the models could be tested with wheels running relative to the wind speed and the team signed a contract with Forti. What formed out of this partnership was Forti's FG01, which was little more than a reworking of the Brabham BT60-succeeding Fondmetal GR02 concept which was designed by Fouche's former Brabham colleague – and then Forti design chief – Sergio Rinland.

To call the FG01 a disaster would be a bit harsh, but a legacy of being the last F1 car with a manual gearbox – and only one on the grid in 1995 – speaks volumes for the car's outdated technology. To their credit, the South Africans were testing the radical new Formula One changes implemented after the Senna tragedy in 1994. The poor performance of the Ford Cosworth ED V8 engine did the team no favours, either. The wind tunnel models, however, were built via stereolithography, which is also known as resin printing; that cool new 3D printing process where the object forms out of a liquid like the T-1000 Terminator.

"The South African mindset wasn't suited to the timescales of F1 and worked better for military contracts, so the project collapsed," explains Fouche. "But I realised while working on that project that I must take this technology further. So I bought a little plotter and a PC and started, but then the need for wind tunnel models evaporated. So I put icing sugar into the machine to decorate cakes by computer. But pumping icing sugar was a bit of a problem, especially with compressed air behind it."

He soon grew tired of the sweet explosions and started using chocolate. "The nice thing about chocolate is that you can heat it, but pumping it is difficult," he tells us. Fouche's innovative mind led him to a solution to his chocolate pumping woes: the peristaltic pump.

"Ever since, I've printed chocolates with my machine," he says. "I then took the Z-axis out because it's very slow when you do it that way. The other very important lesson I learnt in speeding up the process was adding more nozzles. I multiplied a machine with eight nozzles, which prints eight times faster."

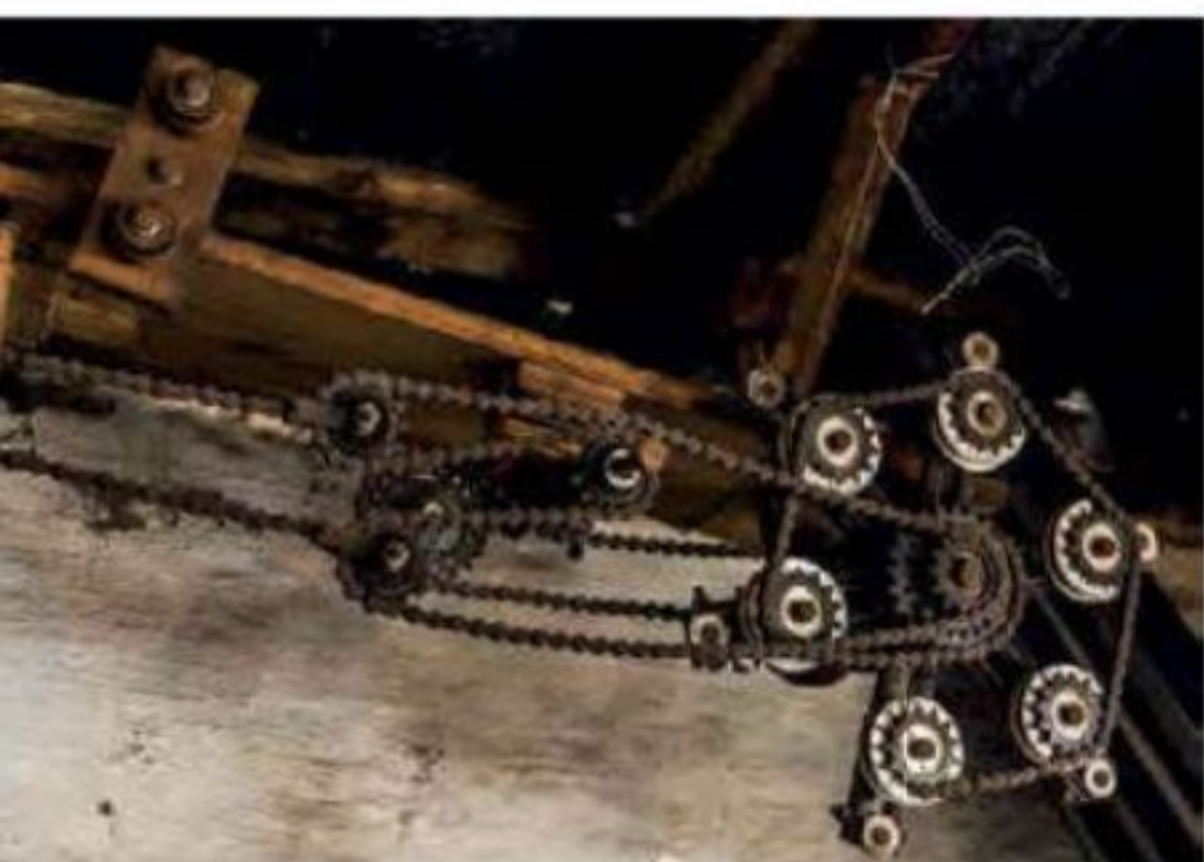
Fouche Chocolates thrived with the two machines, but the technology, stagnated. This was a good thing, because the technology



Below: Fouche's racing car passion is echoed by an abandoned skeleton for a Lotus 7-inspired track car which uses the engine and suspension sub-frame from a Fiat Uno.



Left: The 3D Printer that printed the Cheetah stands abandoned in the garage, stripped of all its worth. Far left: Also in his garage is the "infinitely variable transmission" a concept intended for a motorcycle that will automatically switch between any of 32 gears under full power.



remained expensive and the number of skilled technicians stayed low. Fouche started a new company with two other friends that was to produce chocolates, stained glass and do NC routing for frames. A fatal car accident involving one of the business partners halted development and Fouche then spent the next 18 years without access to this machine control technology to further his interests.

Fast-forward to the age of Arduino, where open source control boards and software became widely available (around 2011) and Hans Fouche emerged from his tragic slumber. "Around the same time I discovered House4Hack and realised that I could do it myself," he explains. "Then 3D printers were becoming available so I bought a RapMan machine and started playing around for a year and put it to work printing small things like rapala lures and plastic washing pegs."

When Fouche 3D Printing was conceived with the products of the RapMan machine, he was still stuck on his multiplication model to speed up production. Then he went bigger. "First I converted the machine to work with a 3 mm nozzle. Then I moved out to the garage and converted one of my idle chocolate machines to a 600 x 600 x 1 000 mm printer. I built all the connecting pieces for the Cheetah."

The Cheetah prints fast and cheap, but the resolution is crude. We say it prints cheaply because, instead of printing with plastic filament at R250 per kilo, the 3 x 2 x 3-metre monster uses ABS

(the stuff you make hard hats out of) pellets which cost a mere R35 per kilo. Combine that with a 500 g per hour flow rate and you have the perfect machine for industrial rapid prototyping. It's also built with the RepRap philosophy, so the business plan is to build more Cheetahs and sell them to industry. And that's the key. The Cheetah isn't intended for backyard hobbyists to make dainty trinkets, but rather an alternative to expensive injection moulding.

Hans Fouche gets ridiculed and derided not for his inventions, but for the presentation. There aren't many makers in South Africa who can boast a CV to match his, but that legacy is also littered with ultimately failed projects and missed opportunities. All he wants is support for his claim for the throne of the maker community. You have to admire his resolve and his vision.

"Being a maker means doing everything yourself. I'm a mechanical engineer, so engineers tend to make a lot of things themselves. Normally you've got the garage, you've got the drill, you've got the press, the hacksaw, the welder. And with these machines (3D printers) you can design projects in CAD, just press a button and there it is. Of course it's not as simple as that, but that's the idea. The other thing is the universal manufacturing machine – the machine that can do it all. This is definitely one step closer to the universal machine. Because you can do ashtrays, the next day you do shoes, the next day you do whatever. In that respect, it's the closest we've come to the universal manufacturing machine."



3D

PRINTING 101

HERE'S WHAT YOU NEED TO KNOW
BEFORE GETTING STARTED AT HOME

BY SEAN WOODS

To say additive manufacturing – or 3D printing as it's commonly known – has a promising future would be the understatement of the century. Granted, although we're nowhere near walking into some futuristic printing shop with the design of our next vehicle (wiring and all) on a flash drive just yet, no one can deny that this burgeoning, disruptive technology has already gone mainstream. We take a peep behind the tech of a typical 3D printing machine.

PRINTER TYPES

FUSED DEPOSITION MODELLING (FDM) printers are what most hobbyists use when conjuring up their own designs. Affordable, they are also available in various sizes, designs and levels of sophistication (think RoboBeast and MakerBot). They print objects by extruding a stream of heated or melted thermoplastic material, which is placed layer upon layer, working from the bottom up.

STEREOLITHOGRAPHY (SLA) machines employ a vat of liquid ultraviolet curable photopolymer resin and an ultraviolet laser to build layers one at a time. The laser traces a cross-section of the pattern on the surface of the resin, causing it to cure and solidify under the ultraviolet light and join to the layer below. Once



Main image: Checking out the future now... visitors at a recent PM display stand around mesmerised as they watch a 3D printer perform its magic in real time. Above: Thanks to the 3D printing revolution, manufacturing your own bespoke items at home has never been easier.

complete, the grown item is washed in a chemical bath to remove excess resin, then cured in an ultraviolet oven.

SELECTIVE LASER SINTERING (SLS) is a technique that uses a high-power laser to sinter layers of powdered materials – typically metals – into solid structures. Needless to say, this technique is more suited to the likes of tech heavyweights the CSIR rather than your average home workshop.

There's a time to be bold. And a time to be cautious.

If there's one thing we can learn from the Titanic, it's that boldness and success don't always go hand in hand. When it comes to investing, we don't believe in a blanket approach either. We weigh up the pros and cons, methodically scrutinise the details and, above all, utilise one of the most widely ignored skills in modern investing – the power of restraint. Because knowing when to be bold, and when to be cautious, makes all the difference. And that's what makes us Wealthsmiths™.

Investments

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TYPICAL COMPONENTS OF A HOBBYIST'S FDM MACHINE

Seeing that FDM printers are what most of us are likely to encounter as hobbyists, here's a breakdown of their basic components:

MOVING MECHANISM

In order to move along 3 axes/dimensions (X, Y and Z) most printers make use of fixed rods, timing belts and pulleys to manoeuvre the print head and/or platform to the exact position required – and small stepper motors permit extremely precise movements of a fraction of a millimetre. These motors are important components as they're in part responsible for the quality of the end product.

EXTRUDER

The extruder's job is to feed the filament into the so-called "hot-end". Extruders are where some of the biggest differences between 3D printers exist, and where the biggest developments are most likely to take place in the future. Some models integrate the "filament driver" as well as the hot-end in one piece; other printers feature a "material feeder" separated from the "extrusion head". Both types have their pros and cons.

RETRACTION

Retraction is a technique that sucks molten plastic back into the heated hot-end. Retracting the filament back into the nozzle just before jumping across gaps prevents cobweb-like thin strands of plastic (called "stringing") from forming – a messy, time-consuming job to clean up should it occur.

DUAL EXTRUDER

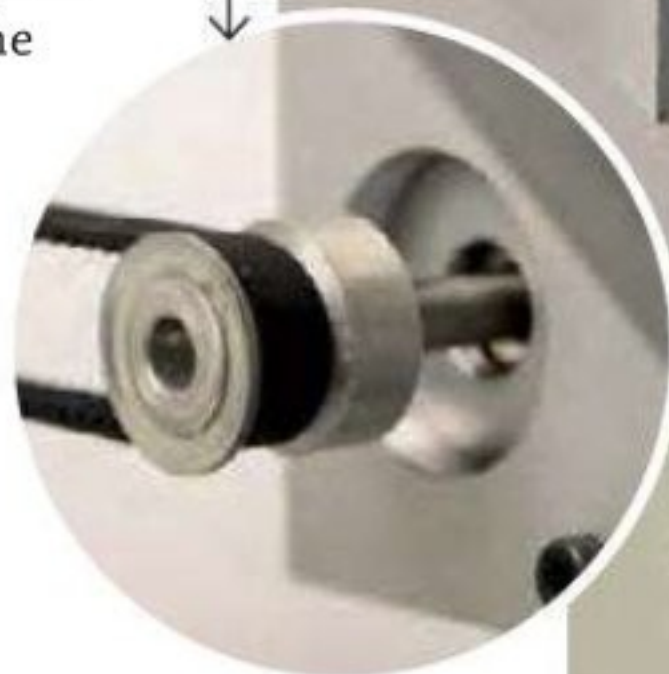
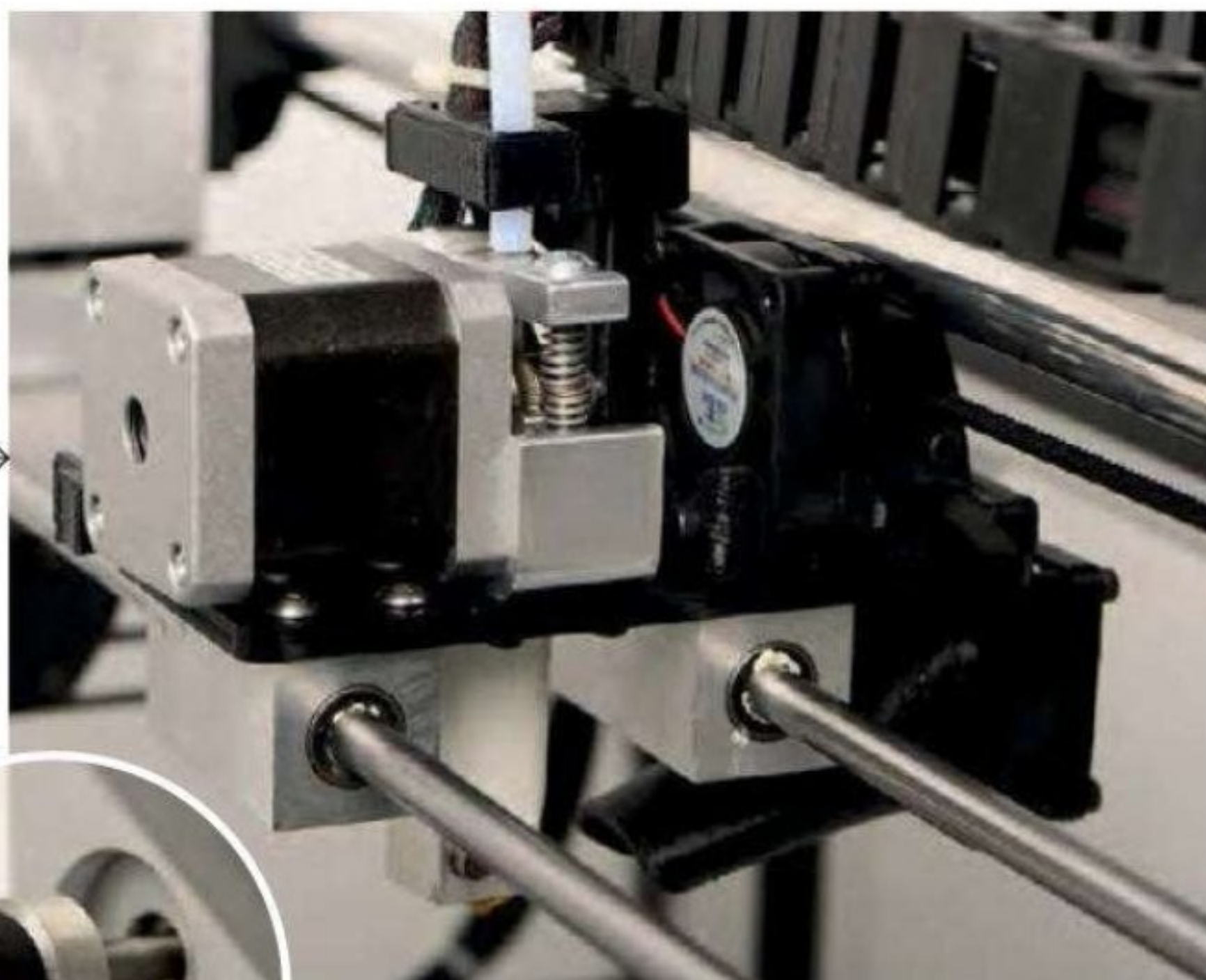
Some printers feature dual extruders, allowing them to print with two filament drivers and as well as two hot-ends – giving you the ability to print in dual colours or even two different materials. This is a great feature for those wanting to print items with large overhangs that require a scaffold supporting structure.

HOT END

Usually made up from a block of aluminium, the Hot End gets heated up to around 250 degrees to melt the plastic filament, and includes a nozzle and heat sensor. Typical nozzle diameters range from 0,2 mm to 0,5 mm in size. The smaller the nozzle, the finer the print, but the longer it takes to complete.

PRINTBED

The most common printbeds are made out of acrylic, aluminium or glass. When buying a printer, always check the exact print-bed size, as it plays a determining factor in the maximum size of your future printed objects. Some printbeds are heated to prevent the warping or cracking of prints, especially when using ABS plastics.



FILAMENTS

The two most common filament types are PLA and ABS. Each plastic has its own physical and chemical properties, so each type needs its own specific set-up within your printing software. Before purchasing any filament, make sure you know what diameter fits your printer.

PM

turn up the heat

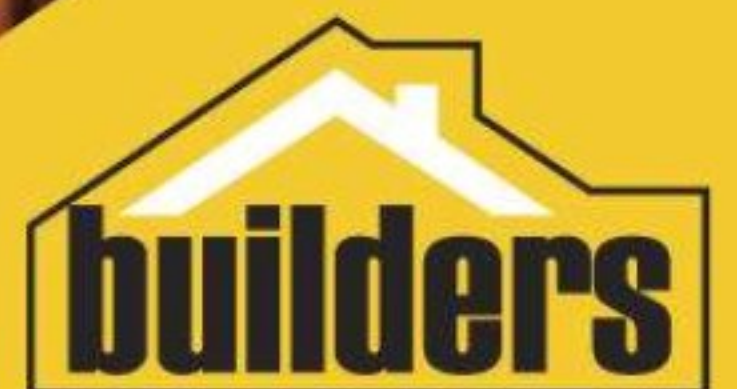
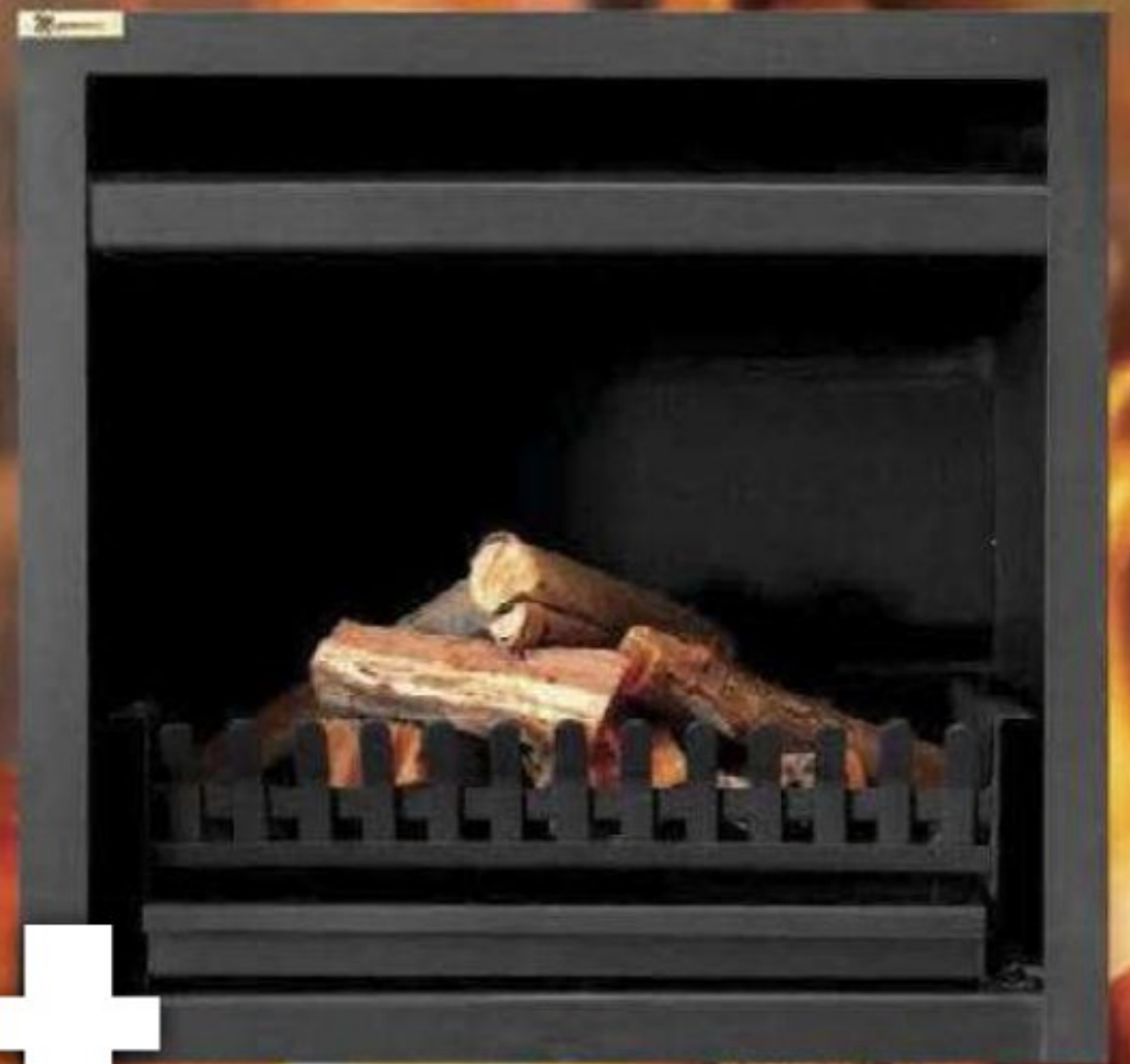
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UPGRADE



OOMI TOUCH

Tap into smart homes

Just when we thought the world was moving towards using smartphones as universal remote controls comes news of a move in the opposite direction. Oomi's modular approach to the smart home uses a dedicated, customisable touch-sensitive controller (it has physical buttons, too) that looks remarkably like a big smartphone or small tablet. However, it will interface with Android and iOS apps for remote monitoring.

The system's hub is the Oomi Cube (main pic). Around R3 500 buys you the basic kit, which includes the Cube, Touch, and one accessory of your choice (bulb, plug or multisensor). There are eight different sensors, including glass break and motion detection.

According to Oomi, you can connect all sorts of things, from door locks that secure automatically when you go out, to air conditioners that cool your home when you're coming back. It's able to manipulate lighting to mimic your home's normal patterns while you are away, so it appears to be occupied.

Components include:

❶ **Bulb.** Lighting ambience effects range from different colours to an unusual gradual sunrise effect or, for evenings, a warm sunset hue.

❷ **Plug.** This creates a "smart outlet" so that hard-to-reach devices can be controlled or have their energy consumption monitored. There's a USB charging port on the side.



❸ **Multisensor.** Detects motion, temperature, light, UV rays, vibrations and humidity.

❹ **Streamer.** Streams HD media directly from the Internet to your television.

❺ **Air.** Oomi air monitors air contaminants to make sure your air is healthy. It senses PM2.5, which are EPA-monitored particles that are one-fortieth the width of a human hair.

According to Oomi, seven unique security features are built into the system. These include 128-bit encryption for every communication, both between devices inside your home and between your home and the cloud.

To avoid getting locked into a closed ecosystem, Oomi is integrated with other technologies such as the next generation of Z-Wave, the most widely used wireless home automation technology.

Three accessories, the developers estimate, is the threshold point at which users really start to reap the benefits of having a smarter home. Adding an accessory (estimated price: about R600) is as easy as tapping the Touch controller.

Operating range is up to 100 metres outdoors; indoors range depends on the construction of the house.

Accessories build a mesh network, which means that the more you have the better signal all of them will receive.

Oomi's Indiegogo campaign is substantially oversubscribed – by mid-April it had raised nearly 8 times its \$50 000 target. Production is expected by September.

Find out more: oomihome.com



THE BEST OF THE BASICS

With the Rebar, Leatherman fans will immediately recognize the iconic box-like shape found in Tim Leatherman's original PST design. The Rebar pliers have been optimized for strength and feature replaceable wire/hard-wire cutters. With all the features to get even the toughest jobs done, in a smaller, slimmer size, the Rebar is sure to be an instant hit on job sites and home projects the world over.

REBAR™

17



*Make
Dad's Day*

Father's Day
21 June



- | | |
|----------------------------------|--|
| 1 Needlenose Pliers | 10 Regular Pliers |
| 2 154CM Replaceable Wire Cutters | 11 154CM Replaceable Hard-wire Cutters |
| 3 Ruler | 12 Electrical Crimper |
| 4 Saw | 13 420HC Knife |
| 5 420HC Serrated Knife | 14 Wood/Metal File |
| 6 Phillips Screwdriver | 15 Small Screwdriver |
| 7 Bottle Opener | 16 Awl w/Thread Loop |
| 8 Can Opener | 17 Large Screwdriver |
| 9 Wire Stripper | |

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SOUNDS BETTER THAN IT READS

Schiit Audio Yggdrasil DAC

It took five years of research to come up with the most tongue-twisting name in audio, Yggdrasil. Actually, we made that up: it took that long to develop the new flagship Schiit digital-to-analogue converter. Yggdrasil (in Norse legend, the “world tree” or source of all things) is, say the guys at Schiit Audio, an entirely different take on “end-game” DAC design.

“Yggdrasil was designed with a single goal in mind: to give you the most from the music you already have,” said Mike Moffat, co-founder of Schiit Audio. “It’s the end result of five years of research into digital filter algorithms, resulting in a unique closed-form digital filter running on an Analog Devices SHARC DSP processor, as well as four true 20-bit Analog Devices DACs running in differential configuration.”

Yggdrasil supports all PCM formats from 16/44 to 24/192 through all inputs, including USB, AES/EBU, BNC, Coaxial and Toslink optical. The all-new USB Gen 3 input receiver and Schiit’s proprietary Adapticlock system manage clock regeneration for optimal performance. It outputs both balanced XLR and single-ended RCA (summed) analogue simultaneously.

Schiit Audio was established in June 2010 with what partners Jason Stoddard (ex-Sumo) and Mike Moffat (founder of Theta) describe as a simple, if somewhat insane, mission: to bring superior performance, design and quality to audio products, while manufacturing in the USA. The company’s products span DACs, headphone amplifiers and preamplifiers, starting at around R600 to the Yggdrasil’s R27 500. Unusually, they are heavily focused on direct sales as a means to limit costs.

Find out more: schiit.com

PM





**We create
chemistry
that makes
locked-in
flavors love
bursting out.**

Once its packaging has been opened, food is often quick to lose the freshness and aroma that make it so appealing. It's important that we get the most out of what we have available, as the world wastes about one third of its food. Luckily, chemistry can make a difference.

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Join the conversation at creator-space.basf.com

150 years

 **BASF**

We create chemistry

COMPILED BY THE EDITORS > popularmechanics@ramsaymedia.co.za

PM TESTED

GARMIN VivoActive

SMART BY NATURE

- ✓ Ease of use, accuracy, connectivity
- ✗ Screen scratches easily, dark display

THE INTERSECTION BETWEEN LIFESTYLE AND FITNESS is a busy place these days. Traditional sports watches now seem to be confined to diehard geeks (I know, I'm one) and the initial popularity of fashionable fitbands seems to have waned. Thus we have seen the rise of the combination device – fitband, sportswatch, GPS, smartphone-enabled and above all, stylish. The last point is the important one: after all, for tech to be wearable, first, you'd have to *want* to wear it.

We were given a sneak preview of the VivoActive just a couple of months after its introduction at this year's CES and ahead of its SA launch.

First impressions are that – good start – it's part fitness tracker, part GPS sportswatch and part smartwatch. It's sleek and relatively unobtrusive. It's also impossibly thin and incredibly light. And hallelujah, it's also an actual watch that tells the time until you switch it to its sport mode. All of this means it can be worn all day long.

Activated by a combination of two pushbutton controls and a colour touch-screen with an icon-based interface that incorporates virtual Return and Menu buttons, the VivoActive is not hard to get up and running. Switching over to the VivoActive from my trusty Garmin 310XT was (more or less) intuitive. Without reading the manual, I was able to input my profile. Using it for an activity took a little headscratching until the delay was traced to an out-of-date version of iOS that didn't allow me to update



my version of the Garmin Connect App. Once up to date, though, it was a breeze.

Besides tracking hardcore sport and workout, like regular fitbands the VivoActive also carries out activity-tracking by monitoring your lifestyle, including sleep. A nagging vibrating alarm reacts to inactivity (not during sleep, clearly) and "Move!" appears on the display.

The display is inexplicably dark, though; you sometimes need to squint to read the text and the backlighting is of little use unless you are in an extremely dark coal cellar. I also found a (drat) scratch mark that didn't seem to be there when the device arrived. The rubber strap can feel a little uncomfortable in prolonged use, too. In the white colour supplied it gets grubby quickly and I would go for black. (There are alternative straps, including leather.)

But this is praise with faint damnation. Really, the VivoActive is a great piece of kit.

Being a smartwatch, it connects automatically to your mobile to sync workout data, provide call and messaging alerts as well as app notifications, including social media and weather, and control music replay. There's a Find My Phone widget, too. Outdoor and indoor modes for run, walk and bike, plus swimming and golf, are shown as screen icons. At this stage, apparently, there's no support for multisport (triathlon) or a power meter. It does also lack the dedicated workout planning features of more hardcore sportwatches. But a welcome addition to the Run mode, for me, is cadence.

It excels at its activity-tracking function, whether outdoors using GPS for running, biking or walking, or their indoors equivalents. It supports multiple external sensors such as my heart-rate belt. And the mass of data available for after-workout perusal will have many of you in sports geek heaven: plenty of numbers to crunch as well as clear graphs. Golfers will be pleased to know that its features include shot distance, yardage to the front, middle and back of the green, and yardage to layups and doglegs.

The VivoActive, like other new models from Garmin, benefits significantly from the company's Connect IQ, described as the first-ever open platform for third-party developers to create apps. So there's support for additional widgets and apps, including colourful watch faces and the ability to translate rich sensor data into new relevant metrics. "Even more, developers can create widgets to add to the main screen loop. These can include the score of a big game, or when it's time for users to hydrate during a long run, ride or hike. These apps can be tailored to any individual lifestyle, no matter what device users are using it for," Garmin says.

So the VivoActive is very much a gadget that people – regular folk – will want to wear. But what about those diehard geeks? Will it do the job for them?

I think I can answer that. The VivoActive covers more bases, suits more needs and ticks more boxes than just about anything else the company makes. The price is in the right area for local consumption, though I'm disappointed that it is so much more expensive than the \$249 being quoted on Garmin's US Web site. For those who want the ultimate in flexibility and workout planning, it's not quite there. For the other 99 per cent of the world, it's the killer app of Garmin fitwatches. – ANTHONY DOMAN

Just the facts

SIZE	43,8 x 38,5 x 8 mm
DISPLAY	28,6 x 20,7
RESOLUTION	205 x 148
WEIGHT (WITH BAND)	38 g
WATER RATING	5 ATM
BATTERY	lithium-ion, rechargeable
RUNTIME	
WATCH/ACTIVITY TRACKING	up to 3 weeks
GPS	up to 10 hours
PRICE	R4 499 (with HRM bundle, R5 099)



PM TESTED



SAMSUNG GALAXY S6 AND S6 EDGE

FEELING GOOD

- ✓ It's beautiful, display, camera
- ✗ It's decadent, lack of expandable memory, non-removable battery

THE EDGE VARIANT OF THE GALAXY S6 looks like a Daft Punk helmet. The sheer audacity of the beautiful curves can make you forget how distracting the reflections you catch on the unusual angles truly are and that, with a 50 per cent production yield, Samsung makes two curved glass panels for every one S6 Edge ordered. It's a decadent device that raids your bank account and the Earth with equal brutality.

When the test units arrived, it was the standard S6 that first reached our desk. Samsung went all out in exorcising the demons that plagued Galaxies S4 and 5. Gone is the sluggish and overbearing Touchwiz. Away with mediocre camera performance. Out with the unreliable swipe fingerprint sensor. Down with plasticky cheapness. This is metal-cladded glass sandwiching of the highest order, with a truly excellent camera and vivid screen to match.

Then the Edge arrived and completely realigned our perception of what a premium flagship device can and should be. "It looks better than the iPhone 6!" exclaimed one devout Apple fanboy. The girls in the office wanted to just be around it. Birds appeared in my bedroom to catch a glimpse (true story). But whereas the Edge adds eye candy to an already great smartphone experience, the display creates problems when text melts into the curve and your Instagram feed gets slightly distorted.

Samsung gave us the superb camera experience with the Note 4 already and the performance upgrade isn't really that noticeable over the Galaxy S5. Even the Galaxy A3 can match the S6 in the selfie department and harsh edges of the Galaxy Alpha brought the premium feel in spades.

Yes, Samsung has blended all its best elements into one flagship phone, but

the trade-offs are massive. What good is a fantastic camera that shoots in file sizes upwards of 4 MB when the phone doesn't have expandable memory? Why would you revert to the slower micro-USB 2.0 port when the micro-USB 3.0 is backwards compatible and more than doubles the data transfer rate? And who signed off on a smaller, non-removable battery to drive a higher-resolution screen?

The Galaxy S6 is deeply flawed genius with painfully average battery life, great design, the best screen and represents the best Galaxy S since the S3. If you can't swallow the premium price, you can always settle on a Note 4 and get all the same photographic bells plus the S-Pen whistles. We're happy that Samsung leapfrogged Apple in terms of camera performance, display quality and design and are excited to see the iPhone's comeback later this year.

— LINDSEY SCHUTTERS

■ Part 4 of our 10-part series Motorsport Technology Down the Ages

Power vs poise

In their own way, two polar opposites define the end of an era in Formula One racing: the delicate, aerodynamic, cigar-shaped Cooper T51 with its central cockpit and rear-mid engine vs the traditional long-nosed Ferrari 246, with the driver perched near the rear wheels, staring down the formidable length of a bonnet that held a brawny V6. The world was entering the Swinging Sixties – and motorsport was about to embrace, completely, a design concept that would revolutionise top-flight racing.

When Grand Prix motor racing restarted after World War II, car design was more or less cast in stone: front-engined, their long noses housing air intakes with grilles to feed the powerful engines. Never mind that the mighty Auto Unions that dominated pre-war racing were rear-engined.

It's said that British constructor John Cooper went the mid-engined route because this was more practical for his early lower-formula cars, which used motorcycle engines with chain drive. But there was another, even more practical benefit that would soon become apparent – and deadly effective. Mid-engined cars had inherently better weight distribution and, consequently, better handling. With a heavy engine up front, cars tended to understeer, though their power advantage offset that to an extent.

The first works Coopers, which made their debut in 1957, caused a few ripples (Jack Brabham managed a sixth place at Monaco), but didn't upset the establishment. A year later, though, things began to change. Privateer teams began running Coopers and, with rule changes that levelled the playing field, suddenly things didn't look quite

so rosy for the front-engined brigade.

Stirling Moss drove the privateer Team Rob Walker Cooper to victory in the season's opening race in Argentina – the first Formula One win by a rear-engined car. Maurice Trintignant followed with another Cooper win in Monaco. On faster circuits the more powerful front-engined competition still ruled, but the rear-engined cars managed enough points to finish the season in third place.

The real breakthrough season was 1959. The Rob Walker Racing Team, their Cooper T51s fitted with a 2.5-litre Climax four-cylinder, were utterly dominant, winning five out of eight races and earning a title win for Jack Brabham.

Power, it seemed, wasn't much good without poise.

Unconvinced, Ferrari stuck with its front-engined 246 and paid the price. For them, the 1960 season ended with a miserable third place in the manufacturers' championship behind a once again triumphant Cooper/Brabham combination. The other teams were beginning to sit up and pay attention, too – notably, Colin Chapman's Team Lotus. An innovative designer, Colin Chapman set the template for many successful cars to come with his rear-engined Lotus 18 and, by 1960, was scoring wins.

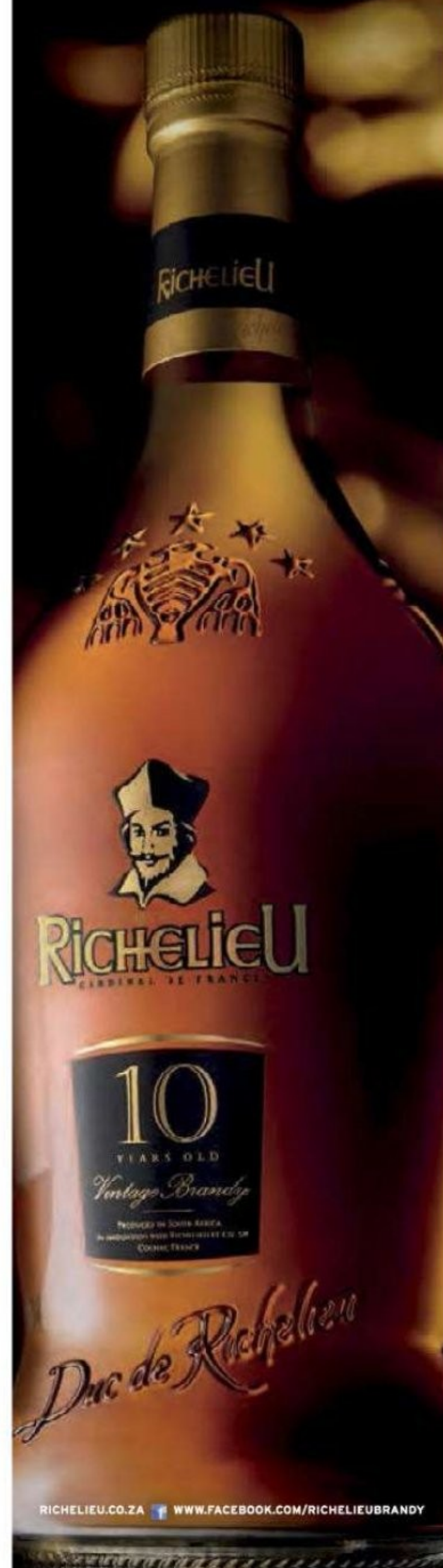
There was one last hurrah for the front-mounted engine. Phil Hill drove his Ferrari to victory at the manufacturer's home event, Monza. It was a pyrrhic victory; the British teams boycotted the event, citing the dangers of the circuit. It was also the end of an era: the last championship race victory for a front-engined car.



The Cooper Climax V8 engine nestled in the spaceframe chassis of the 1963 championship-winning Lotus 25 epitomises the rear-mounted concept.

STUART GRAY/ALAMY

A WINNING FORMULA



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Not for Sale to Persons Under the Age of 18.

AAXA P3X PICO PROJECTOR

SHOW AND TELL

- ✓ Lightweight, small and portable
- ✗ Focus wheel can be tricky to use, no remote control, onboard sound quality is not great

THE NEW PICO PROJECTOR from AAXA, the P3X, is a lightweight, portable projector capable of projecting and playing 720p media files from a memory card or USB drive, as well as content from your computer or DVD player. The P3X also offers you the ability to connect to most mobile devices via a HDMI port. Although the device has inbuilt speakers, I must confess that the sound is not fantastic. Fortunately, the P3X offers you the option of connecting to an external audio source via either the AV port, USB port or the audio output.

Being a portable projector, it can't really compete with larger projectors, but it does offer an adequate 70 lumens of LED brightness that is able to produce an 80-inch image in the dark. I found the image/video quality to be best at around 40-inch, which is ideal for watching movies at home, or for your work presentations and meetings.

— JESSE HENNEY

Just the facts

BATTERY	lithium-ion
RUNTIME	2 hours
LAMP LIFE	15 000 hours
CONNECTS TO	Most smart devices.
PRICE:	R5 499
AVAILABLE:	iStore or contact Above and Beyond Distributors on +27 861 777 258 or www.above-beyond.co.za



BRAVEN 705

MUSIC ON THE MOVE

- ✓ Lightweight, small and portable
- ✗ Focus wheel can be tricky to use, no remote control, onboard sound quality is not great

THE BRAVEN 705 is a portable Bluetooth speaker that can fit many of your audio needs without breaking your wallet. It has some pretty impressive – dare I say unique – features at this price point, including the ability to charge your phone and other devices via the inbuilt battery, which does come in handy with modern smartphones. It also has Bluetooth audio passthrough, which can plug into your stereo for extra bass, as well as IPX5-certified water resistance. Admittedly, I didn't actually throw the Braven into the pool to test this claim, but it will survive a splash or two as you do your Karaoke thing in the shower. It also has plenty of wireless runtime and the built-in rechargeable battery means you can take it virtually anywhere.

But enough about the peripheral stuff; what is it like as a speaker? Pretty darn good. It is surprisingly powerful and the clarity is excellent when playing music. I paired it with my mobile phone and it handled phone calls with aplomb, too. I can't really fault it from a functionality perspective either: it was really easy to pair with all of my devices and the controls are simple and large, which as a man I found to be a useful feature.

— JESSE HENNEY **PM**

Just the facts

DIMENSIONS	159 x 66 x 46 mm
WEIGHT	339 g
BATTERY	1 400 mAh lithium-ion
WIRELESS RUNTIME	12 hours
WIRELESS RANGE	10 m
INPUT	3,5 mm stereo,
DRIVERS	2 + passive radiator
PRICE	R1 699
AVAILABLE:	Exclusively at the iStore
CONTACT:	Above & Beyond Distributors on +27 861 777 258 or visit www.above-beyond.co.za



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During the week, it performs work and school-run duties with aplomb. Come the weekend, however, and it morphs into a gravel-road machine that takes the tasks of adventure-seeking fathers and their families in its stride. Keeping them safe on all these memory-making journeys are seven airbags, ABS and electronic stability control, while entertainment is provided by a comprehensive entertainment system with USB and Bluetooth. Capping this fantastic package is a comprehensive 3-year/90 000 km service plan. The SX4 truly is the car for all reasons. www.suzukiauto.co.za



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Getaway

ride

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LEARNING

TO FLY

TAKEOFF

An acclaimed novelist takes the controls of an aircraft for the first time.
And he's scared to death.

BY JOSHUA FERRIS



I WAS TERRIFIED. I DON'T MEAN OCCASIONALLY.

I MEAN THAT TERROR, AS AN EMOTION, as a prevailing mood, had overtaken my life. I woke in the night gulping for air, my heart going faster than ever. Why? Another bad dream. It was 3:13 am. There was no getting back to sleep. In that dark and terrible hour, I thought dire things.

From where did the terror spring? How could I put it back in the bottle? I didn't know. I couldn't trace it back to any one thing. I was about to turn 40. Was that it? In the end, I assumed it was death. Death, for me, is bound up in everything: my fear, my ambition. Humour, sex, the urge to travel. Death is why I shouldn't drink. Death is why I do.

Last summer, I watched my dad die. That might have been the source of it. I saw him laid out upon a hospice bed in the library of his house in Park Ridge, Illinois. It left me feeling more vulnerable than usual. Or perhaps – and this was the most terrifying thought of all – the terror sprang from nothing and was here to stay.

That summer was a good one for terror. ISIS. Ebola. The kidnappings by Boko Haram. Russians invading Ukraine. Israelis and Palestinians at war again. The police shooting in Ferguson and the mess that followed. Warnings of drastic climate change and continued odd weather. I saw birds flying what seemed like meaningful patterns and I thought nothing was immune from the taint of terror.

So what did I do? I decided to learn how to fly.

To go up in the air inside a machine is a very stupid thing to do. It is also transcendently cool and extremely practical. We go up for sport. We go up for commerce. We go up for war.

We go up so effortlessly and routinely these days that it's easy to forget what it entails: the elevation of a mighty payload of metal and fuel, with souls aboard, by the incorporeal air. Physics says it's possible over and over again on the departures board at JFK, but common sense stubbornly insists that it's just plain dumb.

The variable in every flight is the pilot. The laws of physics might be absolute, but with human beings there are no guarantees. Physics doesn't care what the pilot does, because whether the pilot lives or dies, its rules will be respected. Physics is like the indifferent farmer in Bruegel's *Landscape with the Fall of Icarus*: as the prideful pilot-child plunges into the sea, physics ploughs on with its day's work.

Today, flying is nothing. We've been doing it for over a hundred years. The golden age of aviation gave way to the golden age of air travel, which has soured into a protracted era of airline-induced misery. The contemporary commercial flight is a shrug

and a hassle. The seats have shrunk, the crew hates the passengers and the passengers hate each other, and for everything there is a fee.

Romance has quit the skies.

But do it yourself – pilot a plane from takeoff to landing, in command of every climb and dive – and see if

your pulse doesn't quicken and the raw colour come back to your eyes. The question is no longer: can we fly? The question to ask yourself is: can I fly?

I TOOK FLYING LESSONS for four months from Tom Fischer, who, with his wife, Jodi, runs Fischer Aviation in Fairfield Township, New Jersey. Seeing Tom for the first time, my initial thought was that a man could not have been better engineered for flight instruction. A pale man of substantial build, with eyeglasses and a shaved head, he split the difference perfectly between an Army general and a sixth-grade maths teacher. If he seemed reserved at first, laconic in the style of a military man, and if I generally liked my teachers verbal and outgoing, that was okay. His first task was to keep me alive, and I didn't mind if the job description called for the occasional silence.

My ultimate objective was to fly solo. I was never confident that I would actually do something so reckless and brave. I mean to say I didn't think it possible, either physically or psychologically. I'm not a mechanically inclined man, but I am a man scared to death of flying. Sweaty palms, rapid heartbeat, darting eyes, hands gripping armrests, tears on standby, a scream ever perched on the edge of my teeth. And that's before takeoff. For me, there is terror, and then there is the terror of flight.

I was not always so afraid. In the eighties, after my parents split and my mom moved us away, I'd board a plane several times a year for Chicago. These trips north were my reason to live. They reunited me with my dad. I loved airplanes back then, even the weird engine sounds and Reagan-era turbulence. The

stewardesses gave me a pair of golden wings to pin to my shirt, and when I was really lucky, a free can of Sprite all to myself. At that time, anyone could go to the gate without a ticket, so I'd come down the gangway to find my dad standing there with a big smile on his face, tears in his eyes, arms spread wide, and I'd run into that man's embrace and breathe in his after-shave and I'd know that I was home.

Joshua Ferris is the author of three novels, including *Then We Came to the End*, a finalist for the National Book Award, and *To Rise Again at a Decent Hour*, nominated for the prestigious Man Booker Prize in the first year American writers were eligible to receive it.



LEARNING

TO FLY

Much later, in 2003, I boarded a flight out of John Wayne Airport in Orange County, California. I was by then a nervous flier, which I differentiate from the wreck, the puddle and the basket case. I was, in other words, acquiescent but attentive. I listened for changes in engine noise, alive to every ripple and quiver of rough air. Some flights departing John Wayne are required to climb very high very quickly and then cut back the engines to reduce noise as they glide over the wealthy neighbourhoods down below. For a full minute, it felt to me like I was inside a rocket. When we levelled off, the first thing I noticed was the sunlight. As it streamed in through the windows across the aisle, I seemed to be able to pick out each individual ray. That was the cabin beginning to fill with smoke.

Two things happened next. The first was the sounding of a

high-pitched, continuous, not-too-loud bell – the smoke alarm. The second was a faint odour, indisputable and growing stronger: an industrial smell, like someone using turpentine to burn a plastic toy. By the time my fellow passengers stirred from their naps and magazines, we were in the thick of an emergency. Panic set in quickly. There were screams, tears. The woman in front of me began to hyperventilate. The plane turned back, but because we had climbed like a rocket, we now had to come down like one. The descent did not seem planned or orderly. It felt like we were crashing. The captain offered us no reassurances, only a single, harsh instruction: “Breathe through your shirts.” I watched in dismay as the stewardess, stricken and useless, put on her chest harness. The woman next to me kept asking between sobs if we were still over water. We were. I put my arm around her. I was strangely calm. A mother held hands across the aisle with her son. We all waited for impact.

But impact never came. We touched down shakily, but intact. We were met by emergency vehicles. We filed off the plane. Two free vouchers arrived in the mail a few months later, along with an explanation. The motor responsible for pressurising the air had burnt out and released smoke into the cabin. The plane itself was fine.

But part of me feels like I’ve been living on borrowed time ever since.

“What’s the worst that can happen to me?” I asked Tom before we took our first flight together.

“On a training flight?”

I nodded. Tom and I were very different men, if based only on our choice of professions. I’m a writer who never enjoys lifting my butt off the office chair. Ideally I don’t leave the house, and a perfect day is one in which I don’t get out of bed. Tom, on the other hand, departs the earth multiple times a day.

“People unfortunately die in flight training,” he said after a long pause. “I would think that would be the worst thing.”

Ha ha. Yes.

“I tell people all the time,” he added, “it’s a lot of fun, but it’s not a game.”

With that, we headed out to the airfield.

The last time someone taught me to do something big with a machine, I was learning how to drive. By then I had moved north to live with my dad. He had been teaching me to drive for years. I was 7 when he first put me on his lap and let me steer the car around the parking lot. Now I was old enough to do it on my own. At night, on sleepy suburban streets, he and I went out and worked on things like signalling and turning and braking on time. I was a trepidatious student. The simulation videos in Driver’s Ed instill in the sensitive young man the conviction that, at any given instant he is about to strike and kill a child on a tricycle. I didn’t want to kill anyone, so my general approach behind the wheel was to look, accelerate, brake, look, accelerate, brake, until, inch by inch, we made our way down the street. This tried my father’s patience. He was a man who liked speed.

During my time in the air with Tom I would be reminded of all the time I spent in the car with my dad. My reluctance to assert myself on the stick and rudder was not unlike my reluctance to go above fifteen miles per hour while white-knuckling the steering wheel. At a certain point in my driver’s education, when I knew how to accelerate and brake and all the rest, and the only thing that stood between me and authority was fear, useless fear, my father said to me, “Just drive the damn

‘I WANTED TO RUN AWAY WHEN I LEARNT THAT THE PLANE WAS NEARLY 50 YEARS OLD!’







LEARNING

TO FLY

car!" This command came back to me from the beyond at some point during my flying lessons. Twenty-five years later I was still listening to my old man. Now I sometimes think that the story of how I learnt to fly is really just the story of how I learnt to stop worrying and fly the damn plane.

I WOULD LIKE TO INTRODUCE YOU to my airplane. We call it Six-Two Romeo, after the call sign painted on its fuselage. It is a single-prop Piper Cherokee Cruiser. It has four seats and wings perched below the pilot rather than above. It has a wingspan of nine metres and weighs 570 kilograms fresh from the bath. It's a snug ride. Tom and I sit thigh to thigh. The student is on the left, the instructor on the right. The plane is engineered with dual controls. Its underbelly is painted brown, with twin ribbons of gold flowing along the fuselage. There was, I thought, something dated about its design. I asked Tom what year the plane was made.

"1966," he said.

That was the first time I wanted to run away. (I would want to run away with stunning regularity, often while 2 500 feet up in the air.) On the one hand, a plane built in 1966 has demonstrated an extraordinary safety record. On the other hand, sooner or later, everyone's luck runs out, and that Cherokee had almost

fifty years under its belt. How much more could we reasonably expect from it?

"Isn't that kind of old?" I asked him.

He paused before answering. "I was born in 1967," he said.

We began to laugh. Ha ha ha.

My problem was a lack of faith. In order to better understand people who deny scientific knowledge that I find easy to accept, like evolution or the man-made causes of climate change, I merely need to remember my skepticism towards the indisputable physics of flight. I had a hard time believing that flying was possible, no matter how often I'd gone up and come safely back down. I didn't just think Tom's 1966 Cherokee alone would

fail to hold together. I thought every plane I boarded would fail to hold together. A thing of such size, subject to such wear and tear, was bound to break apart, inevitably with me in it.

A year or so after my emergency landing at John Wayne Airport, when my fear of flying was at its most rabid, I tried to get a handle on it. It was summer, and I had an oscillating fan going in the bedroom. During the hot months that fan went round and round all day and all night. I looked at it, at its spinning blades and rotating head, and wondered why I never had the same worries about it that I had for all the planes I boarded. The stakes weren't the same, of course, but was an airplane not a machine like the fan? The fan worked unflinching, without a single hour of maintenance, and had for years and years, and I never once questioned my perfect faith that it would continue to do so for years into the future. Why should I not have the same faith in an airplane? If anything, an airplane is subject to more scrutiny than a household fan, its use is heavily regulated, and entire maintenance crews are devoted

to keeping it safe and operational. After this little epiphany, whenever I boarded a plane, I took enormous comfort in my simple fan and its continuous and faithful turning.

Then the fan broke.

THE AIRPORT OUT OF WHICH Fischer Aviation operates is called, informally, Caldwell Airport. It's off Passaic Avenue, hidden behind some chain-link fencing. Blink and you'll miss it. Compared with Newark or JFK, it's a parking lot full of toy planes and a patch or two of tarmac. (I was surprised to discover during my time in the air just how many little airports there are, at least in that corner of New Jersey, several of which are uncontrolled. Accustomed as I was to the strangulating regulations of commercial flight, I found amateur aviation still very much a scrappy, DIY thing, just some guys taking their winged go-karts up for a spin.)

Out by the plane, the first thing Tom and I did was go through the preflight checklist. Never am I more skeptical about the ultimate wisdom of our experts in aviation than when I see some short-sleeved pilot suffering the indignities of wind and rain to stand beneath the belly of a plane and eyeball the structural integrity of a row of rivets. That's it? I think. That's safety? But it was no different with Six-Two Romeo. Tom and I crouched and contorted, we loomed and looked as we inspected the plane's bolts, pins, winches and wingtip lights. We felt down the length of the propeller for any imperfections. We stopped before the cowl (what I wanted to call the hood), and Tom popped it open like the lid on a lunch box to reveal an engine that could have been started with a few yanks on a pull string. We checked it for fire damage and the presence of animals. In everyday life, I have grown accustomed to a computer or some other device mediating between me and the world. The digital magically renders error and danger obsolete. But search an engine for animals and you know you're back to the basics. It's just you and your eyeballs and whatever faith they can lend that the engine hasn't been molested by some rabbits.

As things progressed, I continued to see just what a thoroughly analogue experience flying can be. In Six-Two Romeo there is no autopilot, no computer, no digital communication between the pilot and the controls. A commercial Airbus or Boeing jet might be one intricate and high-powered mainframe, but Tom's Piper Cherokee was a distant cousin of the lawn mower. Expand the motor on your rider and take away a wheel, enclose the seat and add one for a buddy, throw on a pair of wings, and presto. Your grass eater is now ready for takeoff.

It was kind of thrilling. Here was a well engineered (if a tad aged) block of metal and wire nestled inside an aerodynamic hull. It was going to put me up there in the blue sky as if by magic. And I would guide it there using nothing but my hands and an intimate physical knowledge of how it worked. No updates, no inputs, no hitting enter. Just me and the 1.0 world.

Once through with the inspection, we climbed into the cockpit. We put on seat belts escaped from the back seat of an Oldsmobile. The analogue nature of the Piper Cherokee continued to reveal itself. The yoke, which controls both the pitch and the bank of an airplane, moved in and out and left to right with the matter-of-fact functionality of a primitive arcade game. The rudder pedals at my feet were notched, metallic and brutal. There was a trim tab control (I did not know what any of this meant practically) affixed to the ceiling that resembled the hand crank of a window in a municipal building, while the wing flaps were controlled by what looked like an emergency brake lever. I would come to learn that at certain critical moments, such as landing, the pilot, manipulating all of these controls at once, can look not unlike one of those multi-instrumentalists simultane-

THE WORLD

WAS SUDDENLY

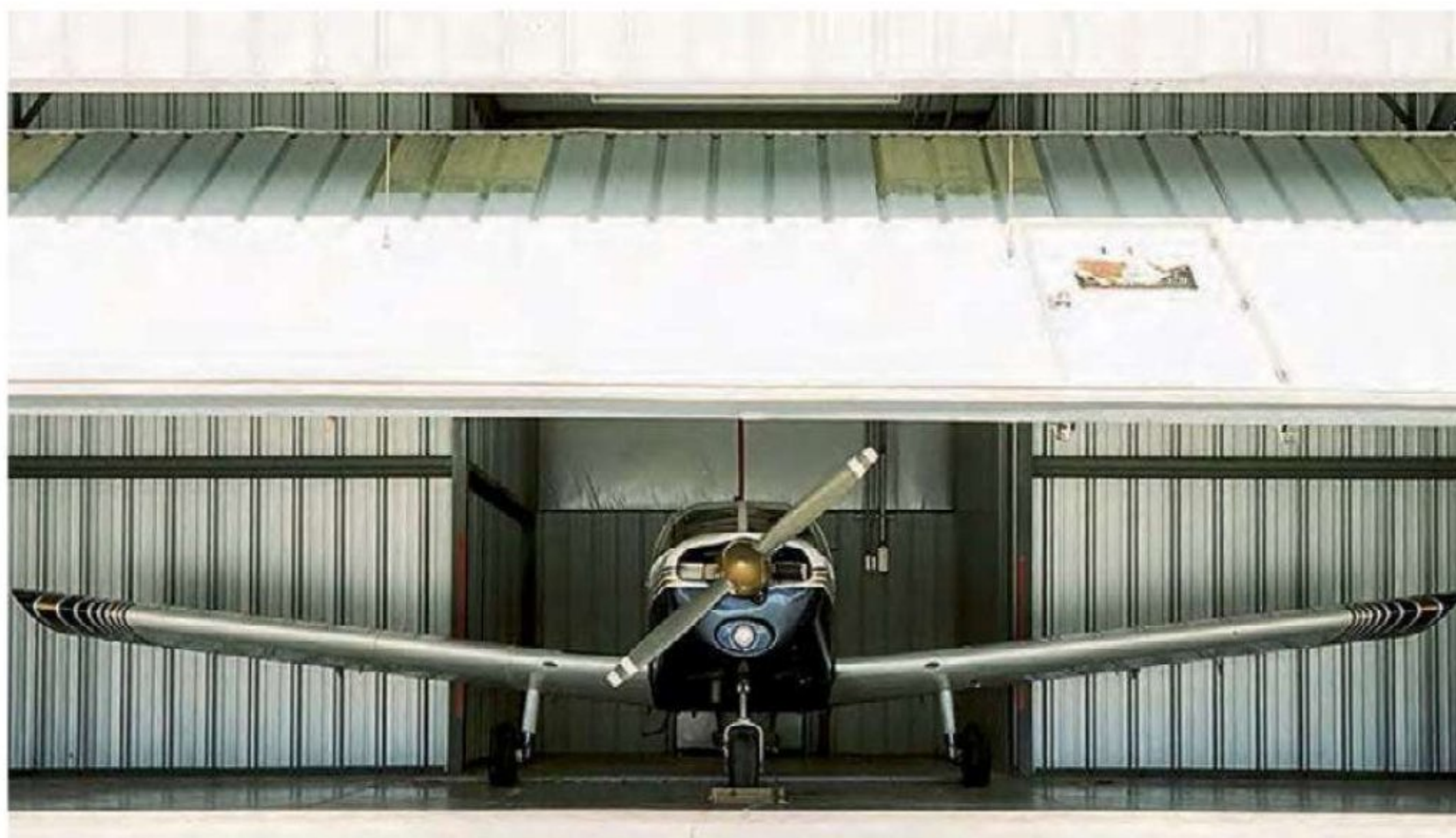
UNRECOGNISABLE

AND MORE

DANGEROUS THAN

BEFORE. MORE

VULNERABLE.



ously strumming the guitar, blowing the harmonica, and tapping a foot drum.

I started the propeller with the push of a button. I struggled to insert my two headphone jacks into the instrument panel – a poor harbinger of my competency with the more complicated controls before me. Then Tom radioed to air traffic control and we taxied to the runway.

As I sat before the yellow lines waiting for takeoff that first time, my heart banging for its jailers inside my chest, I had second thoughts. Even now I wonder: would I have started down the path towards a solo flight – what I had begun to call my date with the NTSB – if I had known then what was coming? I'm thinking of the time, six lessons in the future, when I pointed the plane at the runway nose down as we were landing and didn't know it until Tom took the controls. Or the time I failed to recover from a stall because I forgot how, and instead of pulling back on the yoke to initiate a positive climb, I just let us fall, with stomachs bottoming out as we stared down at the tops of trees, until Tom took the controls. Or the time I just let go of the yoke at a critical moment and Tom said, "Don't let go!" Or the time I should have gone around during a touch-and-go but decided to try to land anyway, going too high and too fast, and we wobbled violently very close to the ground until Tom took the controls. Or during yet another landing, when I came into ground effect and suddenly yanked up on the yoke so hard that we started to climb again, but having such little speed we were close to stalling out, and Tom called for more power to get us out of that mess, but, for reasons that still elude me, I simply didn't react, and we might have dropped to our deaths if he hadn't, once more, taken the controls.

I didn't know any of that before taking off with Tom for the first time down runway 22 in

'THERE IS NO AUTOPILOT'

Six-Two Romeo. I couldn't have anticipated the number of times he'd save my hide from ruin, or how frightening it was to play back the day's mistakes, or how the airplane would start to invade my dreams. I sensed only my fear, as well as a vague necessity.

My father couldn't breathe towards the end of his life. Pancreatic cancer, which he'd somehow gotten the better of for seven long years, had finally overtaken his lungs. In the days and weeks after his death, I, too, couldn't breathe. I felt, in life, little distinction between my dad and me. We extended our imaginations to one another. That's what love is. It was impossible for me to stop doing so just because he was dying. If he could ail, I could ail. If he could die, I could die, too. The world was suddenly unrecognisable and more dangerous than before. More vulnerable. More terrifying.

It took months after my dad passed away for me to understand that I wasn't going to follow him immediately to the grave. It was his turn, unfortunately, not mine. I wasn't even 40 years old yet. No matter how wrecked I felt as I watched him die, I wasn't going to just give out. Neither was that old Piper Cherokee, not with the love and attention Tom paid it. I had to have a little faith. I was scared, but I had to live. For me, and for my old man. And what's the best way to live in the face of death?

Fully is always the best way to live.

Just fly the damn plane.

So when Tom gave the command to engage the throttle on Six-Two Romeo, I engaged the throttle, and we turned, and took the centre line, and off we went, down the runway and into the air.

PM

WHEELS



Compiled by
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A MERCEDES SPORTS CAR COMES DOWN TO EARTH

THE 2016 MERCEDES-AMG GT S IS MORE PRACTICAL THAN ITS PREDECESSORS, BUT IT'S STILL JUST AS FAST.

Nine years ago the flagship Mercedes was the SLR McLaren 722 Edition. That car did zero to 100 in 3,6 seconds, cost around R5 million, and looked like the SL500's coked-up uncle. It was replaced by the SLS AMG, a car that seemed sensible by comparison – it was just as quick off the line as the SLR but cost less than half. Now the SLS is gone, replaced by the Mercedes-AMG GT S, which starts at about R1,5 million (in the USA) and does zero to 100 in 3,7 seconds (close enough). As far as Mercedes performance variants go, this is the democratisation of power.

There is, of course, a catch. To keep the price down, AMG had to dial back the outrageousness and build a more conventional sports car. The SLR had a carbon-fibre tub and scissor doors. The SLS had gullwing doors attached with pyrotechnic bolts, in case you flipped it over and couldn't get out. The GT S makes do with

regular front-hinged doors, which, I admit, work just fine. But, unfortunately, you no longer look like an astronaut exiting your lunar capsule every time you step out at Dairy Queen.

My GT S drive begins in Miami Beach, which is a tough place to exercise a twin-turbo V8. So I head over to the Grand Theft Auto badlands of downtown Miami, where one can still find empty streets and room to run on any given weekday morning. Over there, in the shadows of the overpasses, you have to do more than squeal the tyres to draw a second look from the cops.

And I certainly did get a little bit obnoxious. The GT S has an exhaust-bypass button that diverts as much as 95 per cent of the exhaust flow around the mufflers, sending V8 bass echoing off the bridge abutments and shuttered storefronts. Conventional wisdom says that turbochargers act as mufflers, but the GT S is



375 kilowatts, zero
to 100 in 3,7 seconds



a rolling refutation of that idea. It's not quite as loud as a Jaguar F-Type V8 S – not much is, outside of large artillery – but you won't weep for the departed 6,2-litre V8 that powered the SLS.

You also won't miss the SLS transmission, because it's still here. The GT S gets the Getrag seven-speed dual-clutch transaxle last seen in the SLS AMG Black Series. Situated over the rear wheels, the transmission contributes to a 53 per cent rear-weight bias that helps the GT S deploy its 375 kilowatts. Flatten the accelerator and the tyres issue a tortured wail, but refuse to go up in smoke. This is a sports car, not a German Hellcat.

In fact, the AMG GT S feels a lot like an SLS AMG – similar acceleration, similar sound, similar view over that long bonnet – but at a huge discount. So I understand the logic of taking AMG's halo machine down to less rarified air. But I'll still miss looking like an astronaut. – EZRA DYER

**FLATTEN THE
ACCELERATOR
AND THE TYRES
ISSUE A TORTURED
WAIL, BUT REFUSE
TO GO UP IN
SMOKE.**



THIS MONTH IN CARS... IN MOVIES

In *Beyond the Reach*, a very rich hunter accidentally shoots a reclusive prospector in a remote desert, then tries to cover it up by leaving his young guide to die in the heat. There are four main characters: the man (played with a sinister charm by Michael Douglas), the guide, the desert, and a car. A big car. A six-wheel-drive Mercedes G63 AMG that looks like a safari war limo. The limited-edition vehicle was originally designed for the Australian army, with a few extras made for oil barons and anyone else who needed people to know they could find hundred dollar bills in their couch cushions. The standard AMG has 400 kilowatts, 37-inch tyres, and adjustable tyre pressure. The one in the movie also has a motorised gun compartment, an espresso machine, a PA system and articulating automatic floodlights, but, sadly, no speaking parts. – PETER MARTIN

THE DOWNSIDE OF LED HEADLIGHTS

PEOPLE THINK YOU'RE A HIGH-BEAMING JERK.

The guy across the intersection flicks his high beams at me, just like the oncoming car did a kilometre ago, just like a bakkie will do a few minutes later. They're telling me that I've spaced out and left my high beams on, that I'm a negligent dummy with his brights ablaze. Except my high beams aren't on. I'm driving a 2015 Kia K900 with LED headlights, and everyone thinks they're too bright. What's going on? The issue, I think, is that each LED lighting element is so distinct. The K900 has four low-beam LEDs on each side, so oncoming drivers perceive four individual lights rather than one big bulb. The general public, accustomed to composite headlights, is disarmed by the white, naked splendour of LEDs. So they high-beam you.

As for the people who think I'm blinding them, I conduct an impromptu public education seminar. I flick the Kia's headlight stalk and give them a taste of actual LED high beams, which light up the intersection like Rikers Island searchlights during a prison break. They won't flash me again.



ILLUSTRATION BY KAGAN MCLEOD



THE ARMCHAIR TEST DRIVE

VOLVO'S NEW VIRTUAL-REALITY SMARTPHONE APP LETS YOU TAKE A SPIN FROM YOUR LIVING ROOM.

I've already driven the 2016 Volvo XC90. Not in person, mind you. I've driven it on a virtual-reality headset. Which is just a cleverly folded piece of cardboard with my iPhone inside. Welcome to the age of the Google Cardboard test drive.

Volvo Reality is one of the few iPhone-compatible apps for Cardboard, a DIY viewer made using free instructions online. The free app splits your screen to give each eye a slightly different view, while the phone's accelerometer tracks head movement to adjust the scene. Put it inside cardboard and voilà: 3D. Next thing you know, you're flying into the wilderness to drive a Volvo.

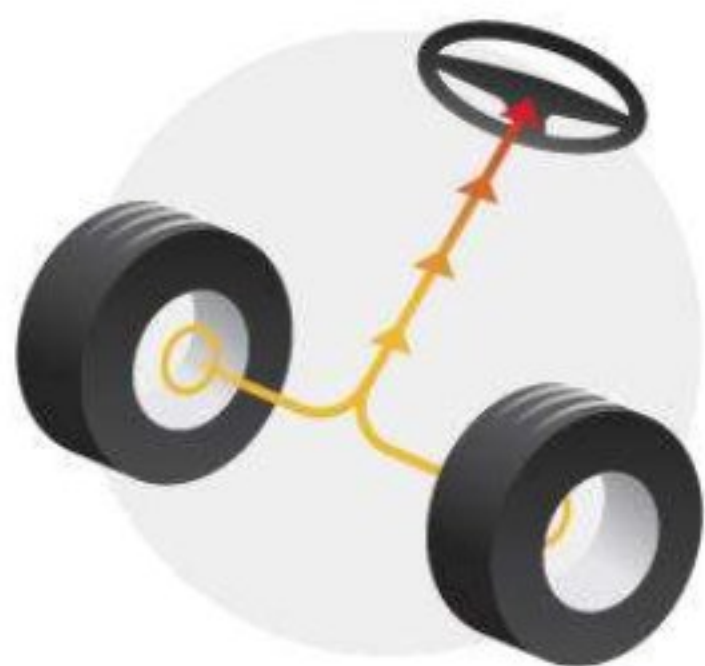
Episode one opens with a black XC90 parked among trees. Soon you're inside, driving along a bucolic mountain road. The view is from the driver's seat, but there are no hands on the wheel. Help, I'm trapped in a ghost car! You can look around the interior as you drive, and why not? This thing practically drives itself.

Eventually you end up at a lake, and a graphic reads, "Friday, 8:27: My home for the night." At first I assume I'm sleeping in the car, but if you swivel your phone around you see a tent down by the water. Although I still think I'd prefer the car. That interior looks pretty nice.

Volvo's other app

A couple of months back, an executive from a luxury carmaker was talking up the range of its new key fobs, particularly the remote-start function. I said, "Oh yeah, well, the Volvo On Call app lets you start your car from your iPhone." He replied, "Yeah, we thought about offering remote start through our app. The problem is, how do you keep someone from starting the car when it's in a garage?" The implication is that, through malice or mistake, someone could start a car indoors and inadvertently gas the place with carbon monoxide. So I asked Volvo if On Call can tell the car's in a garage. Answer: not right now. On the other hand, nefarious remote starting hasn't been an issue. Still, the app suggests leaving your hood popped to prevent an accidental startup. Want to be really sure your car doesn't start? Disconnect the battery.

PHOTO ILLUSTRATION BY ALBERTO SEVESO



IN PRAISE OF HYDRAULIC STEERING

BECAUSE IT'S STILL THE BEST YOU CAN GET.

Electric power steering is so prevalent that I just assume every new car has it. So when I'm hustling the 2015 Subaru WRX STI down a country road, its wheel alive with feedback, I think, finally! Someone's figured out how to build a really excellent electrically assisted steering system. Then I reach a stop sign, turn the wheel, and watch the tachometer dip as the engine lugs – the telltale sign of a hydraulic pump imposing drag. Indeed, the STI is one of the few hydraulic holdouts, and as a result it might have the best steering of any new car, a system perfected over years of development. Of course, the STI also gets a miserable 12,5 litres/100 km combined, a figure that would doubtless be higher if Subaru went electric. But in this case, Subaru has its priorities in order. And everybody else has a benchmark: want to build the best steering system? Make it feel like a 2015 STI.



FORD FOCUS

NEW SOPHISTICATE

The act of fitting a modestly sized car into a typical parking bay clearly seems to defeat many drivers, judging by the evident bumps and scrapes in supermarket parking areas. Perhaps it's regular cars driven by regular people, not premium models (driven by premium people, no doubt) that need hands-free parking.

So, many will welcome Ford's introduction of hands-free Perpendicular Parking (right) in its new Focus. But there's a lot more to the latest iteration of Ford's international best-seller.

The new powertrain line-up, for instance, is said to deliver fuel efficiency improvements of up to 19 per cent. It includes, for the first time in South Africa, the International Engine of the Year (3 years in a row) 92 kW 1,0-litre EcoBoost engine as well as a 132 kW/240 N.m 1,5-litre EcoBoost. Industry-first Enhanced Transitional Stability is a tech highlight on the running gear side.

Look ma, no hands. Perpendicular Parking (a segment first for Ford) is a new hands-free parking technology that helps drivers reverse into spaces alongside other cars. The current Focus introduced parallel parking aid Active Park Assist, which uses ultrasonic sensors to locate parallel parking spaces



and steer the vehicle while the driver controls the accelerator and brake. The addition of two new sensors to the rear of the new Focus enables Perpendicular Parking to operate in the same way. The extra sensors make it possible to implement tech that helps drivers manoeuvre out of parking spaces, too, in the form of Cross Traffic Alert and Park-Out Assist.

JUST THE FACTS

ENGINE	1,8 TSI
OUTPUT	141 kW, 320 N.m
TRANSMISSION	6M or 7DSG
0-100	6,7 s
PRICE	R326 400



VOLKSWAGEN POLO GTI

SHIFT IN EMPHASIS

Whether or not it's a fact that true enthusiasts prefer manual shifting, it very much is a fact that buyers of the Polo's big brother Golf GTI prefer the automatic DSG gearshift. It could be that they simply can't be bothered with shifting, or (more likely) that they enjoy the DSG's characteristic vroom/burp/vroom upshifts and blipped race-style downshift.

So at launch the Polo GTI arrived with only a 7-speed DSG. However, in the second half of 2015 a 6-speed manual option will be on offer. Then no doubt we'll see who the *real* enthusiasts are. By the way, the DSG version gets 5,6 litres/100 km, the the manual 6,0. Just saying.

The preceding Polo's 1,4-litre engine makes way for a 1,8-litre direct-injection turbo from the same family as the 2,0-litre used in the Golf GTI. Also new for 2015 are optional Sport Select suspension with electronically adjustable dampers, paired with a track-capable Sport Performance kit, and optional LED headlights.

MERCEDES BENZ CLS 400 BORN TO BE WILD

Don't let the elegant style and modest badging fool you, that three-and-a-half-litre V6 lurking under the bonnet is drama waiting to unfold. The cabin is teeming with all the typical upscale Merc trinkets right down to four different seat massage settings and side bolsters that move to embrace you in the corners, but the powertrain is pure madness. Turn off the traction control and you can treat yourself to all the sideways mayhem you can ever want. Or cruise the unsealed streets of the Kasi with the ride height up and everything all comfy. We've been a fan of the CLS arc since its first debut and, judging from the thumbs-ups



and double takes, it seems the rest of the country also loves that dramatic curvature. You can lowball for the entry-level 350 or go large on the AMG 63, but throughout the full model line-up, the 400 offers the perfect proposition of mind-blowing performance and pampering comfort.

INFINITI QX80 OUTTA MY WAY

The imposing 8-seat QX80 casts a huge shadow. Its bold styling may not be to everyone's taste, but there's no denying that it makes a statement. Throw in a beefy direct-injected 5,6-litre V8 and All-Mode AWD system with Auto, 4H and 4L modes, various terrain settings and lockable rear differential, a Hydraulic Body Motion Control (HBMC) system said to help reduce body lean in turns and air-based self-levelling and it's clear the QX80 has earned the right to play in the premium SUV class.

Challenge No. 1 involved threading the QX80's formidable bulk along the picturesque but narrow Montague Pass. Fine, but then there was the matter of the oncoming

bakkie... fortunately, our paintwork remained unblemished thanks to the standard camera set-up with its bird's-eye view facility.

Extended stretches of particularly dodgy gravel didn't raise a sweat. Well, mostly. Heading into a dip, with the suspension heavily compressed, we realised too late that lurking in the shadows was a protruding lump of rock that had the potential to spoil our entire day. Even as we winced, we were through the obstacle. We needn't have worried: the QX80 didn't even appear to bottom out. A second eyes-wide moment involved the opposite – an uphill, the equivalent of a hump-backed bridge. The big Infiniti briefly lifted off. Re-entry was accomplished with minimal fuss.

On a popular Southern Cape dune trail, we found the wheel/tyre combination to be generally equal to the

task, when deflated to 1,0 bar. At times, though, it's necessary to exercise a little care because there is such a thing as too much torque, apparently. (Don't ask us how we know this.) It's a good thing the sophisticated traction control (the 4wd system is apparently similar to that used in the high-performance Nissan GT-R) makes everyone a smarter driver.

Overall, the QX80 feels as composed on-road as off it. The ride could be more refined, I reckon, and at times it's noisy and there's a knobby feel on irregular surfaces. Whether this can be traced to the big wheel/low-profile tyre combination used on our launch vehicles is hard to say.

Infiniti is banking on its big luxury SUV's blend of performance and features stealing some sales from customers who might otherwise be considering less plush vehicles at a similar price. It's offered with a huge range of standard convenience, luxury and safety features that make it a very competitive offering. – AD

JUST THE FACTS

ENGINE	5,6 V8
OUTPUT	298 kW, 560 N.m
TRANSMISSION	7A
ECONOMY	14,8 combined
PRICE	R1 238 000



SUBARU WRX STI

LATE BLOOMER

Once the king of performance hot hatches, the WRX STi has fallen from grace quite spectacularly since those heady days of Ken Block videos. Consider this then a triumphant comeback. The obnoxious rear wing and meaty exhaust note tell a tale of the lunacy that lies under the aggressively styled body panels, but don't accurately capture the elegance of the combination mechanical and electronic centre differential. If you know what you're doing you can tune that diff to a frighteningly specific power distribution bias. The traction control can also be tinkered with, but the one thing that we wish the geniuses at Subaru would add is a suspension setting. It won't break your back, but it does a good job at trying

when you're travelling on anything other than F1 quality asphalt. Much has been said of the manual-only gearbox option, with an embarrassing video showing a Golf R running away from the STi, but this car feels little for straight-line speed and ease of use. If you want a street-tuned rally car then get this. The clever torque vectoring and rapid steering rate sing a glorious song of driving nirvana on a winding mountain pass; so sweet is this siren tune that it even makes the super hard suspension make sense. Yes, there are more accessible and quicker ways to enjoy four-wheel-drive performance, but would you rather perform surgery with a scalpel or a steak knife? The acres of turbo lag, lack of dual clutch transmission and harsh ride may be drawbacks, but drive this thing properly and you'll be smiling for weeks. **PM**



JUST THE FACTS

MAX POWER:	221 kW
MAX TORQUE:	407 N.m
0-100 KM/H:	4,9 sec
PRICE:	R629 000



2149 CARS ONE *car*

SA'S BEST-SELLING MOTORING MAGAZINE



carmag.co.za  

SKILLS

The Warn PullzAll is a battery-powered winch that weighs eight kilograms, but can pull or lift up to a half-ton.

REMOVING THE BACKYARD COLOSSUS

BY ROY BERENDSOHN

ILLUSTRATIONS BY
TIMOTHY J REYNOLDS

The chain-link fence, the slab of asphalt, that huge boulder. This winter, it's finally time to rid your property of eyesores.

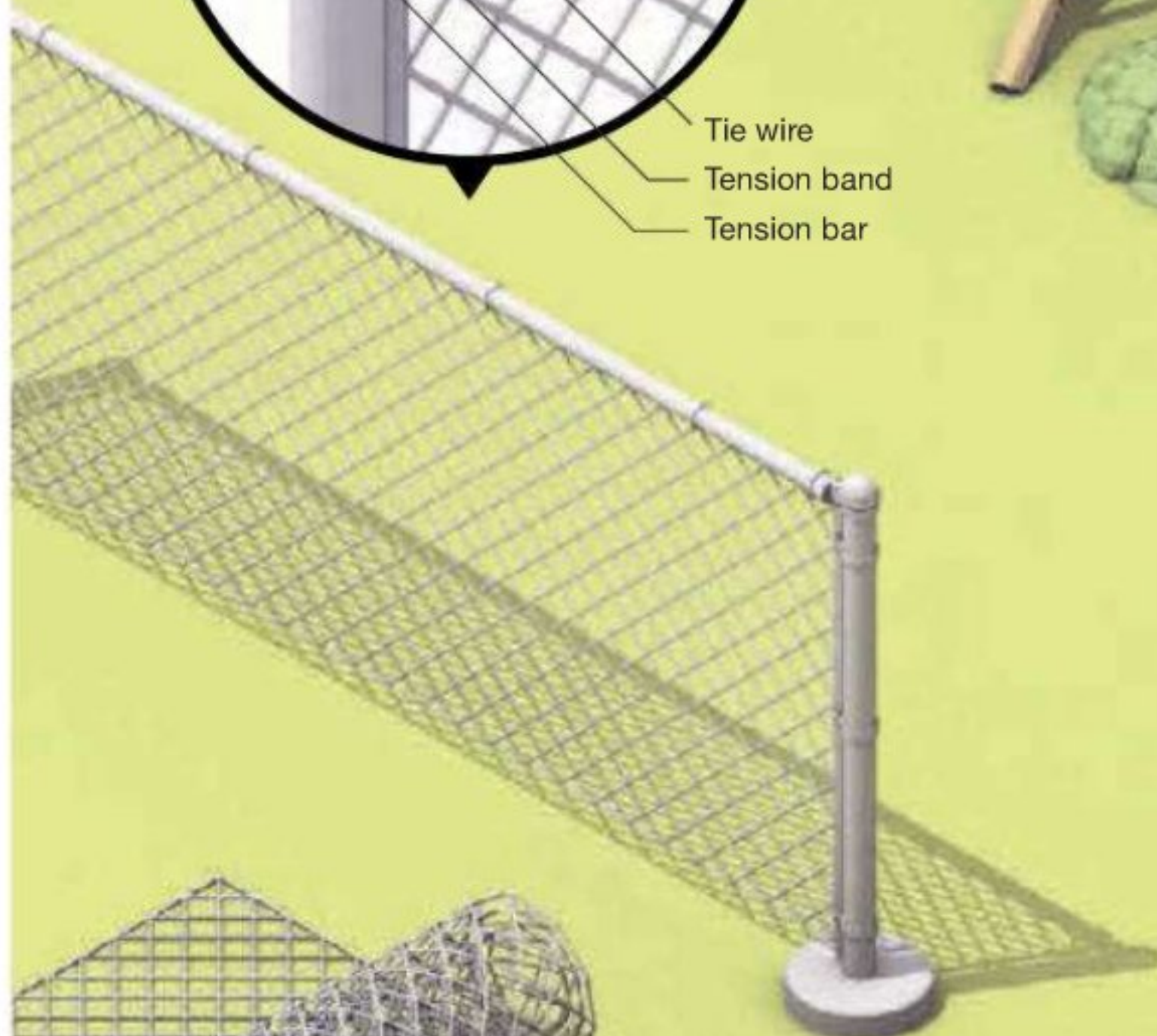
SKILLS

YARDWORK

• ANATOMY OF A CHAIN-LINK FENCE •



Tie wire
Tension band
Tension bar



THE JUNK: CHAIN-LINK FENCE

A rusty old fence on a property speaks volumes about its owners. Or, rather, it shouts really unfortunate things about them to the entire neighbourhood, such as "We're weird, and our devil dog might eat your children." But you only have a cat!

GET RID OF IT

1. First, snip the tie wires that hold the fabric of the chain link to the top rail and posts, then loosen the bolts on the tension bands, the connectors that hold the tension bar to the end posts. Do the same to the brace bands that hold the top rail to the other posts. Drop the chain-link fabric and roll it up. Slide the top rail out and set it aside.

2. The end posts are usually set in concrete. Dig an oval-shaped hole around the concrete footing and pry it out using a pinch-point bar. The post itself also works as a lever if you pull the top towards you, then rotate the footing up and out of the hole. Alternatively, a large hydraulic fence-post jack can pull a post out of the ground, footing and all. If you rent one of these, you'll find it's worth every cent.

3. If the concrete footing rests far enough underground, you can also use a reciprocating saw with a metal-cutting blade to cut the post flush with the ground and pound the stub with a sledgehammer until it's sufficiently deep to be safe. Sometimes when doing this, you'll get lucky and the footing will break up. Then you can change tack and lift it out in chunks.



THE JUNK: AN OVERGROWN SHRUB

It was probably beautiful when it was trimmed in the shape of an Italian cypress. Now it looks like a freakishly big hamster.

GET RID OF IT

1. Don't start at the trunk. Snip off large branches with bypass loppers until you can get close enough to the trunk to saw it off with a chainsaw outfitted with a semi-chisel chain, which is ideal for hard and dirty cutting conditions. Make sure to leave enough of the trunk to form a handgrip or even a lever to help you get the root ball out of the ground.

2. If you intend to plant in or near the same hole, the stump and roots have to come out. The more treelike the shrub, the more difficult this can be. Expose as much of the stump below the ground as possible by digging around it with a shovel, pickaxe and chisel-point crowbar. Cut the roots using the chainsaw if you can do so safely and without hitting a rock or burying the saw's nose in the dirt. If you can't, use a reciprocating saw and a bimetal blade designed for cutting wood with nails embedded in it. After the roots have been severed and all that's left is an oddly shaped hunk of wood, pry it out with your pinch-point bar. You can put your foot on this in a gesture of victory, if you like.





• HOW TO MAKE A HOLE IN STONE •



THE JUNK: ROCKS

It's like they move themselves to the worst possible place. You dig for a foundation. Rock. Plant a tree. Rock. Lay out a garden? Clear, loamy topsoil. Just kidding: A rock!

GET RID OF IT

To deal with a big one, blast it to smithereens. It's best to get the professionals out for this one because you could damage some-

thing really expensive. There are some micro-blasting kits available, but we doubt your insurance company will cover you if something does go wrong. Rocks are fun.

If we may:

LEAVE THE TREE-HOUSE LADDER

Not the whole thing. Certainly not anything made of plastic. But a weathered board or two nailed sideways to a tree. Sand the edges. Hang a birdhouse. You can figure out some way to make it look nice. A home should have a little history, and if the children of the former owners come to visit, you'll make their day.



THE JUNK: PAVEMENT

A patio whose janky, cracked foundation trips you up while you're holding a tray of freshly grilled steaks is no patio at all.

GET RID OF IT

1. Busting up a concrete slab with a jackhammer is hard, loud, dirty and exhausting, so start with the right machine. They range from tools you can use with one hand to industrial monsters powered by four-cylinder engines. You want the heaviest electric model you can get. These machines weigh about 30 kg and are available at tool-rental stores.

2. Begin at one edge of the pavement and run the breaker's bit straight down to break off pieces that are about 10 cm wide. In most cases the work goes reasonably quickly, but all bets are off if you run into reinforcing metal like rebar or welded-wire mesh.

3. If you do hit metal, you'll need to rent a power cutter, a petrol-engine circular saw equipped with a diamond-impregnated blade that cuts concrete and the reinforcing metal in it.

4. After the slab is broken (or broken and cut), shovel or lift it into a wheelbarrow for transport to a dumpster with a swing-out door. This will allow you to wheel the debris right in and then drag your exhausted body back out. Good job. Go get a beer.

SKILLS

THINGS COME APART

A PHOTOGRAPH BY
TODD McLELLAN

THE OTHER BITS

The Bosch DDS182 drill driver is cordless, brushless and wireless, but still comes with a lot of stuff.

IN GENERAL, THE MORE BITS, accessories and attachments you buy for a drill, the more likely that drill is to be useful. So it might seem strange that today's power drill manufacturers seem intent on removing stuff. Take this Bosch DDS182 drill driver. The drill itself is cordless, its motor is brushless, and the charging system is wireless.

The Bosch still has plenty of parts, of course (see photo). What the manufacturer has removed are the pieces that aren't useful: the ones that stand in the way of the drill in its purest, most essential form. Without a cord, you can take it anywhere you want. Without brushes, the motor lasts longer. Without wires, you can charge it every time you set it down.

More important, the key feature remains: it's great at making holes.

— KEVIN DUPZYK



1 KEYLESS CHUCK:

The Bosch's chuck uses a system of gears to loosen or tighten teeth that hold the bit in place. Older models required a separate tool to open and close the teeth. It was always promptly misplaced.

2 CLUTCH AND GEARBOX:

The gearbox delivers power from the motor to the drill bit. The clutch system decouples the motor from the bit when torque is too high, preventing stripped and overdriven screws. This is a ball detent clutch: a spring presses ball bearings into notches to engage the drivetrain. When the torque overpowers the spring, the balls pop out of the notches, and the clutch slips.

3 CLUTCH SETTING SELECTOR:

Turning this collar to a higher number adds tension to the spring in the clutch assembly.

4 BRUSHLESS DC MOTOR:

Whereas traditional motors rub conductive brushes against a commutator to generate magnetism and, subsequently, rotation, brushless motors use an electronically controlled system that is contact-free. Without friction, a brushless system is more durable.

5 TRIGGER/SWITCH ASSEMBLY:

The trigger is the button you push with your finger. The switch is the electronic device that translates this pressure into a signal the motor understands.

6 DRILL CIRCUIT BOARD:

The tool's control centre. While some manufacturers control the tool from the battery, keeping these functions on board allows the tool itself to fine-tune power demands based on load.

7 INDUCTIVE CHARGING COILS:

Copper in a plastic case. Each coil is, essentially, half of a power transformer – the charger contains one side, the battery the other. When the battery is placed near the charger, the charger's coil induces a current in the battery's coil. This current is then stored as energy.

8 BATTERY CASING:

Made of a heat-conducting material that is moulded into fins to increase surface area, it allows heat to dissipate quickly.

9 BATTERY CIRCUIT BOARD:

First it communicates with the charging station to load energy, then it communicates with the drill to dole it out as needed.





What if I accidentally set my drill bits or pocket change on the wireless charger? Will it charge them?

No. When you set the drill on the base, the charger sends an electronic message to the battery to ensure that it's actually the battery, like an air traffic control tower sends to a plane. If the battery doesn't confirm, the base sends no energy. Which is too bad, because this thing could have been one hell of a mousetrap.

WINNER! of our home workshop challenge No. 2

ROCKET BOAT

The winner of our PM Home Workshop Challenge 2, Matthew Wagner, found that devising a project suitable for an adult and child to do together can be fun as well as a learning experience.

In general, we would advise against using your kid sister as a guinea pig, particularly in matters involving rocketry. In the case of the Rocket Boat, we are happy to declare that you may disregard that advice. Not only will she have a water taxi for humanoid passengers, she will also become an actual rocket scientist.

Final-year mechanical engineering student Matthew Wagner proved the point by designing and building a Miami speedboat with his 8-year-old sister Sara, for her Barbie set. "She absolutely loved helping me design the shape of the craft, then paint and decorate it afterwards," Matthew says. She's subsequently had lots of fun in the water with it, too.

Hopefully, as winner of our Workshop Challenge, Matthew will have an equal amount of fun using his prize: a top-of-the-range Makita cordless impact drill kit valued at R6 794.

His project, Matthew says, is surprisingly simple to build, yet will teach essential engineering and scientific principles*. It can be finished in less than two hours and, as most of the materials are recycled, total cost should be around R40. The basic design is easy, but if you start getting into the fluid dynamics side of things, he says the amount of time required can become insane.

It is based on a traditional water propulsion system. However, instead of using an engine and a propeller to increase the pressure and flow rate of the water through the nozzle, which in turn, creates thrust, an old Coke bottle was used. This is half-filled with water and then air is pumped into the "cylinder" using a standard bicycle



Sara's idea

pump. A simple irrigation valve (micro choke) and an old presta bicycle valve were used to hold the pressure in the cylinder. The micro choke is opened full throttle to send the Rocket Boat whizzing across the water.

Sara did struggle with pumping up the rocket boat to pressure, but she is already looking ahead. "She has asked if we can build a ship for her 'Girl Lego', so bigger vessels with double jets are in store," Matthew adds. "Lastly, one can clearly see that the rocket boat was not the most streamlined super-looking vessel. I believe that letting Sara experience the different materials, learn the procedure, have fun and not strive for perfection was more important for her at this stage. For an older child who desires a more realistic craft, perfection can be attained, though at the cost of more skill and time."

How it's made

Start by making a hole in the bottle cap using a 5 mm drill bit (if the child is young, this part is for adults). The drill bit size will depend on the size of valve you found. The valve must have thread all the way down so that it can be screwed on correctly. This will form the airtight seal at the top. If you struggle to find a threaded valve,

Materials and tools

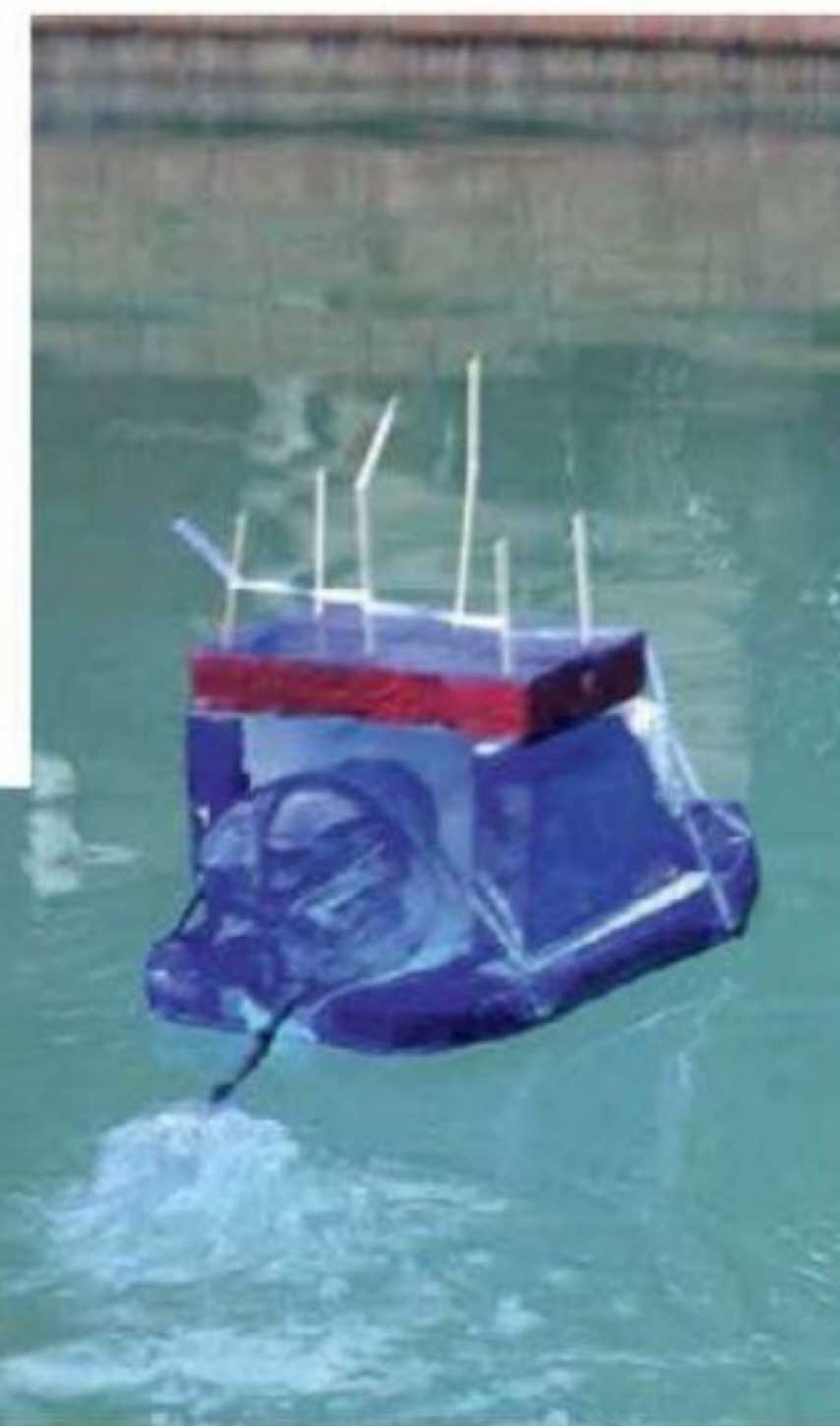
(All available at hardware, craft stores, bike shops or around the home)

A	1	2-litre plastic coke bottle
B	1	Old bicycle valve, tubeless or not. Make sure it has thread all the way to the base.
C	1	Irrigation valve. Size is not really an issue, see picture. Parent see note.
D	1	Irrigation riser (for jet nozzle)
E	1	Polystyrene block (400 x 200 x 100 mm.) This is an approximation; see note.
F	1	Washer (6 mm internal diameter of hole)

Additional

- As needed: elastic bands, cable ties or duct tape.
- Drill for making the hole in the bottle cap into which the valve and rear jet nozzle are inserted (a bradawl can be used with extreme care).
- Glue (Pratley Quickset is a good option) to seal the bottle and hold the rear jet nozzle in place.
- Sandpaper (rough and smooth) 80 grit to 220 grit will do.
- Bicycle pump (used later to pump air into the cylinder).

Note on polystyrene: In the end I used some offcut Isoboards, but any odd bits glued together from washing machine or TV packaging could work.



you can use glue. However, any bicycle shop will more than likely have an old one that they want to throw away.

Then the child can fit the old bicycle valve by inserting it through the pre-drilled hole, placing the washer on the outside and screwing the ring on tightly. A good idea at this point is to test for water tightness. Screw the cap on the bottle and pump it up a little. Hold it under water to see if any bubbles escape. If they do, some glue will seal it.

The next few steps can be joint affairs. First, make a small hole in the back of the bottle. Then insert the small end piece from the irrigation riser and permanently glue in place using a strong adhesive. This is a good time for a marshmallow break to wait for the glue to dry!

Fabrication of the boat hull starts with a choice about the type of craft you want. Fast = long slender hull. Slower but steady = shorter and wider hull. Use the sandpaper and an old hacksaw blade to fashion the craft hull. Note: this is supposed to be fun. You can finish the boat and fine-tune the hull later. You will play around a little to stop it capsizing if you have a craft that is too thin and long, as it will be top-heavy from the bottle on top.

Make a place in the hull for the pressurised cylinder and fuel pack (Coke bottle). Bore a hole out the back of the hull for the jet nozzle to protrude from; in the end Matthew didn't need a hole and stuck it directly into the water. It is important that the jet nozzle is centred and straight. If not, the craft will go in circles. This is not difficult to fine-tune and can be helped by fitting a rudder.

Attach the pressurised cylinder fuel pack using cable ties, strong elastic band or duct tape to the hull. The Wagners used two elastic bands.

Decorating the hull is a likely task for the younger member of the team. Paint it, draw in windows, glue down seats made from leftover hull bits, stick on rails and flags – go wild.

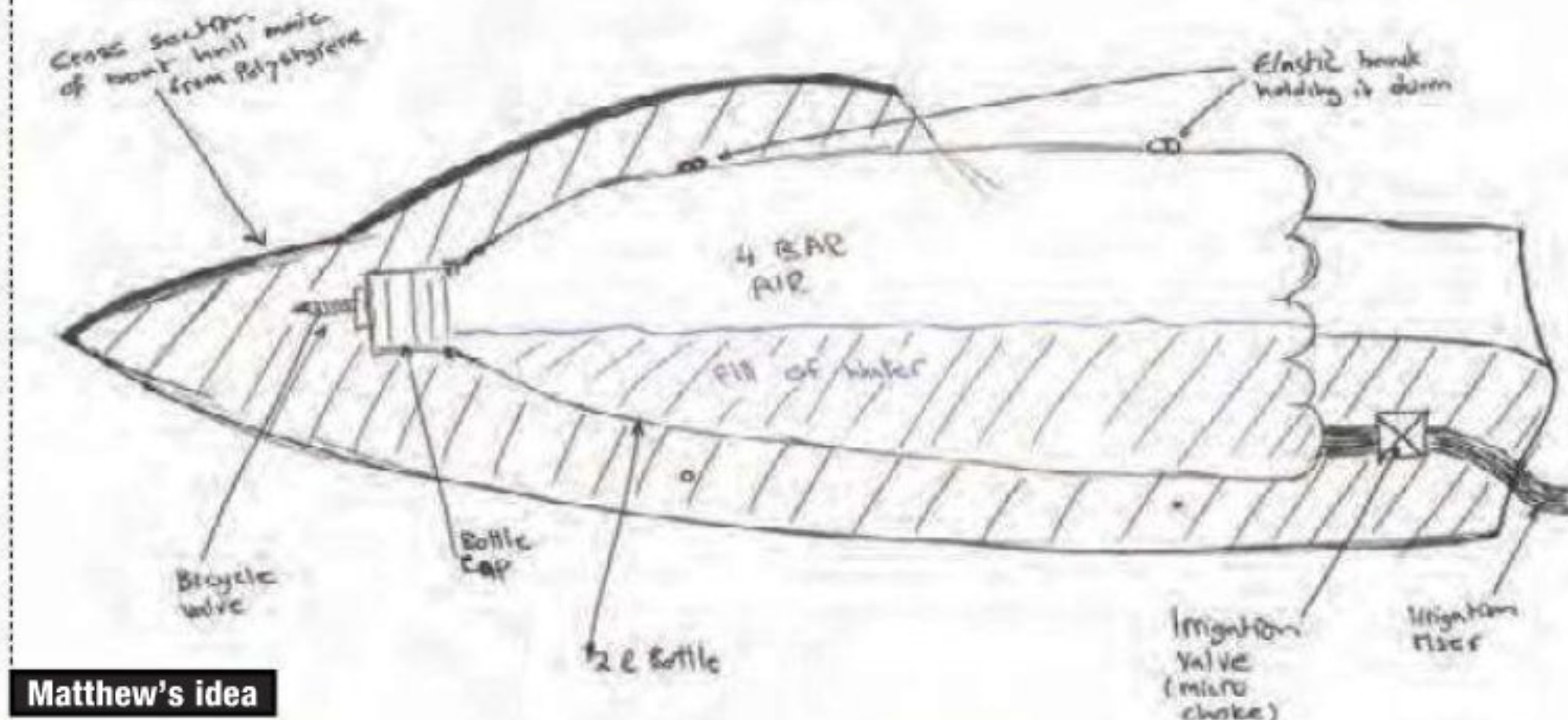
The final joint effort is to put the Rocket Boat into action. Unscrew the bottle cap and fill the 2-litre bottle with water to just over $\frac{3}{4}$ of a litre. Screw the cap back on and

There's plenty of scope for involvement of the younger member of the construction team, as our pictures show, from glueing to painting and assembly. The first test run (right) went perfectly – and when done whizzing across the water the boat makes "some really cool noises and runs on bubbles".

pump it up using the bicycle pump to just below 2 bar for the test run.

Place the craft in a pool, dam or pond, open the irrigation valve and watch the boat rocket away. "We tested our boat to 3,2 bar, no problem – and it really went," says Matthew. There will be some fine-tuning of your design to get it to go how you want. When it runs out of water the craft makes some really cool noises and runs on bubbles.

● And those scientific principles? Newton's Second Law, resistive forces, buoyancy and lots more: Matthew explains all on popularmechanics.co.za – including why we should credit 8-year-olds with a lot more understanding than we do.



Matthew's idea



AND ANNOUNCING: PM Home Workshop Challenge No. 3

Your DIY ingenuity or writing skills – or both – could win you a great prize from Makita in our third PM Home Workshop Challenge. Full details in next month's POPULAR MECHANICS.

SKILLS

APPLIANCES

You have a pocket computer, so your microwave shouldn't look like it came with a slap bracelet. Try the Breville Smart Microwave. It has a sensor that can automatically adjust cooking times.



THE SMART MAN'S GUIDE TO MICROWAVING

A refresher course for the hottest culinary gadget of the 1980s.

BY DAN PASHMAN

A MICROWAVE IS A TOOL that few of us use to its full potential. Cue the physics professor: inside a microwave, a vacuum tube called a magnetron blasts electromagnetic waves at whatever's placed in front of it, the same way a light, an X-ray, or a radio does, but at a different frequency (2 450 MHz). Waves at this frequency, called erm... microwaves, make water molecules in food vibrate, heating them up. To use this information to make tasty food, see below.



High heat causes milk solids to separate. Even putting the butter back in the fridge won't fix that. Cut off the piece you plan to use, set the microwave to medium power, and watch it to make sure you don't overheat.



If you go too long or too hot, you could continue to cook the steak, turning your medium rare into medium well. Instead, let the steak come up to room temperature before heating it on medium-high power.



Honey crystallises when some of its sugars come out of solution, but that doesn't mean it's gone bad. Honey never goes bad. Heating it will allow the sugars to re-dissolve, returning the honey to liquid form.



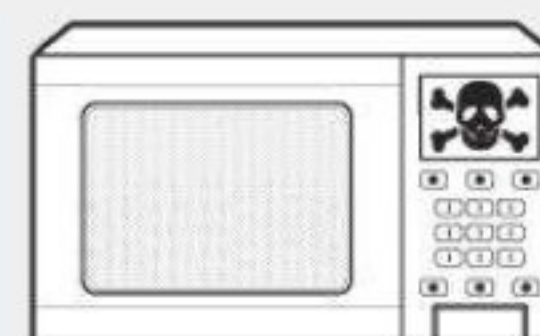
Old rice undergoes a process called retrogradation, in which starch molecules squeeze out water. To temporarily reverse it, sprinkle water over the rice, stir, top with a paper towel, and microwave until it's insanely hot.

THE SORT-OF-SCIENTIFIC SCIENCE EXPERIMENT

Can a microwave interfere with your Wi-Fi?

I've read online that microwaves can derail a software update by interfering with Wi-Fi. But there are a lot of lies online. To learn the truth, I set my iPhone 6 Plus to wirelessly sync music files, and my MacBook Air to stream live TV. Then, with both devices gulping data, I set them on the counter inches below a 2014 microwave, reheating coffee for one minute at 100 per cent power. After just fifteen seconds the data flow to my phone and laptop halted.

Marcus Weber, a researcher at Stanford University, says that this is the microwave signal "saturating" the receivers in my iPhone and MacBook, both of which have filters designed to absorb 2 450 MHz waves. This would be a problem, except that both devices returned to full speed after the minute ended. If necessary, I could set my router to transmit at 5 GHz instead of 2.4 GHz, but even I, a tech editor, can survive a minute without Wi-Fi. — ALEXANDER GEORGE



IS MY MICROWAVE GOING TO KILL ME?

No. Unless you put plastic in it, in which case maybe. The radiation in microwaves does not contain enough energy to remove electrons from cells the way X-rays can. If your microwave's shield is very leaky, it could potentially heat you the same way it heats food, but this is unlikely. However, certain chemicals, such as phthalates and BPA, can leach out of hot plastics and interfere with hormonal signalling, which is not ideal. To be completely safe, use only plastics labelled microwave safe, or put your food on a plate, you animal.

PHOTOGRAPH BY BEN GOLDSTEIN



ASK ROY

POPULAR MECHANICS' senior home editor solves your most pressing problems. BY ROY BERENDSOHN

I have a ceiling light that works sporadically. It's not the bulb. I've taken the light down and looked it over, but couldn't see anything wrong. How hard can it be to diagnose? We're talking one switch and one fixture.

I'm glad you said one light and one switch. Circuits that are more complicated than that usually require an electrician. I think you can handle this, though.

To diagnose this at home, you need a multi-meter, a battery-powered instrument that tests voltage, current, resistance and continuity. Inexpensive versions cost about R100.

In this case you'll use the meter to check for continuity, the integrity of an electrical path. First, cut off the power to the light at the service panel, then loosen the screws holding the fixture to the ceiling box, lower the fixture, and undo the connectors that attach the fixture's two

wires to the house's wiring. Install a standard incandescent bulb in the fixture. Now set the meter's dial to continuity, and match the meter's leads to the two wires coming out of the fixture. It doesn't matter which lead goes to which wire. If there's a continuous electrical path, the meter will produce a tone. If it doesn't, remove the bulb from its socket and use needle-nose pliers to pull up the brass tab at the bottom. Reinstall the bulb and test again.

If the fixture tests okay, leave the power off and run the same test on the switch: remove the switch from its box and connect the meter's leads to the switch's brass terminal screws. Again, it doesn't matter which lead goes with which screw. When the switch is flipped to "on", the meter should produce a tone. If it produces an erratic tone or no tone, the switch is bad. If both the switch and the fixture test okay, you have a bigger problem. Call an electrician.

Does anybody make a rack to mount a shovel on a wheelbarrow? Every time I move a wheelbarrow with a shovel in it, the handle gets in my way.

A rack strikes me as impractical. Do what countless construction workers do: tuck the shovel's handle under your arm and rest the head in the wheelbarrow as you move it.

Our house has ugly, beat-up baseboard trim that's fastened every 10 cm with a pair of large finish nails. I've damaged the drywall trying to get the stuff off. Any ideas?

One option is to trim over it. Some home-improvement stores have started selling mouldings that are

made from a continuous piece of MDF (a material similar to Masonite) called RapidFit. They have a traditional profile on the front, but the back is an L-shaped cavity. You place the new mouldings over the old and fasten them on with 4d finish nails. Putty the nail holes, paint, and you're in business.

If you'd rather just get rid of the old mouldings, slide the straight end of a fishtail crowbar between the trim and the bottom wall plate and pry forward. That should get the mouldings started. It'll be loud and nasty, but it shouldn't harm your walls.

We've got threaded steel pipe that leaks. My husband has taken it apart, wrapped it with tape, and put it back together. Twice. It still leaks. Can you help?

When a threaded joint leaks, the natural response is to tighten it. Sometimes that stops the drip, but if you over-tighten the joint, you could ruin the threaded parts and make the problem worse.

Most likely only one of the pipe's fittings has stripped threads. To fix it, replace the pipe and bad fitting. There's no need to replace the fitting at the other end. First, apply a generous amount of professional-grade pipe sealant to the male threads of the new pieces.

Once the new pieces are as snug as you can get them with your bare hands, you need only a full turn to a turn and a half with tools. Hold the fitting or the pipe with one wrench, and with another turn the part you are tightening. Plumbers call this back holding. With the right sealant you can send water through immediately.

ARE YOU
SURE YOU
KNOW HOW
TO USE
THAT?

PIPE WRENCH
EDITION

A pipe wrench is a hardy tool, not given to easy breakage like a thin saw or a drill bit. Heck, it's a weapon in the game of Clue. But if you forget to leave a small space between the back of a wrench's hook jaw and the pipe you're gripping, you could strip the teeth, bend the jaw, or damage the tightening nut. A wrench's jaws aren't parallel, and their natural wedging action tightens around the pipe as you turn. "Leaving a space permits the jaws to tighten with just the right amount of give," says Chuck Stephens, director of service and training for Ridgid Tools, who has been using pipe wrenches professionally for 37 years. If you forget the space, you could turn your best wrench into a decorative piece of cast iron, which is only a good thing if you're a blacksmith.

SKILLS

AUTOMOTIVE



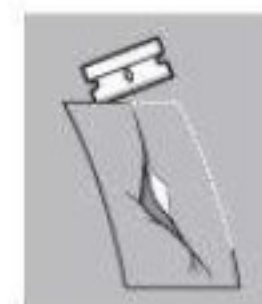
HOW TO

REPAIR A CRACKED DASH

Tips from the Freedom High School Automotive Programme.

STEP ONE

Cut out the damage.



Use a razor blade to cut a border around the damaged plastic or vinyl, then peel or rip it off, along with any other areas on the dash that feel brittle. To check for brittleness, press your thumb into the dash. If the vinyl feels hard or cracks, it's no good.

STEP TWO

Fill the crack.



Next, spray some 3M Polyolefin Adhesion Promoter on the exposed foam rubber. Then apply a thin layer of 3M EZ Sand Flexible Parts Repair, an epoxy

that dries like hard plastic. Cover the entire hole and a bit of the surrounding plastic with a thin layer. Once the EZ Sand is dry (the label should specify the required time), sand it even with the rest of the dash using 320- or 400-grit sandpaper. The patch will be thin. Be careful not to create holes.

STEP THREE

Apply texture and colour.



If you're repairing a large part of the dash in a basic colour like black, you could use a textured paint or even bed liner to cover the damaged area. Both mimic the surface feel of vinyl. For a smaller or more colourful fix, spray a layer of black texture coating paint over the sanded area to duplicate the original texture. When dry, apply a coat of Colour Coat in the same colour as your dash.



NEXT MONTH

BRAKE REPAIR

THE KIDS IN THE GARAGE

How to strip, repair, repaint and rewire an old car – with help from an after-school automotive club. Part four of a six-month series.

WHEN SETH REHRAUER isn't working on cars in the Freedom High School garage in Freedom, Wisconsin, he's likely to be maintaining some very different vehicles at home. "I've been racing snowmobiles for five years," he says. "I have a mechanic who works on my snowmobiles, and he's been teaching me stuff." Rehrauer, a 17-year-old 11th-grader, is currently taking only one automotive class at school, but he also pops by the garage during his study hour and after school to help out. While some kids have been priming and painting the body panels on the 1974 Oldsmobile Delta 88 and the 1981 Chevrolet Camaro Z28 we've been following, others have been working on the interior or mechanicals. For Rehrauer, plastic repair is the hardest skill to master. "It's complicated because you have to lay the repair perfectly," he says. "If you don't, you'll get holes when you sand it. Then you have to redo it." Even with all Rehrauer's extra hours in the garage, he doesn't have time for that.

Above: Freedom High student Seth Rehrauer applies 3M plastic repair to the cracked dash.

THE SUPERGLUE OF CAR REPAIR: SPRAY PLASTIC



Kick panels are called that for a reason. Those quadrants of plastic next to the door and just below the glovebox get more abuse than a well digger's wristwatch. One good boot and you've got a crack. Instead of spending thousands on a new panel, just fix it yourself. Remove the panel, turn it over, prep the surface, and push the plastic together while applying 3M Semi-Rigid Plastic Repair. Once it's dry, reattach the panel and spend the money you saved on something else. A snowmobile, maybe.



This is made out of cardboard, tape and circuit boards we bought online.

The DIY dashboard

Update your ancient car with a touchscreen music system you built yourself. BY ERIC KESTER

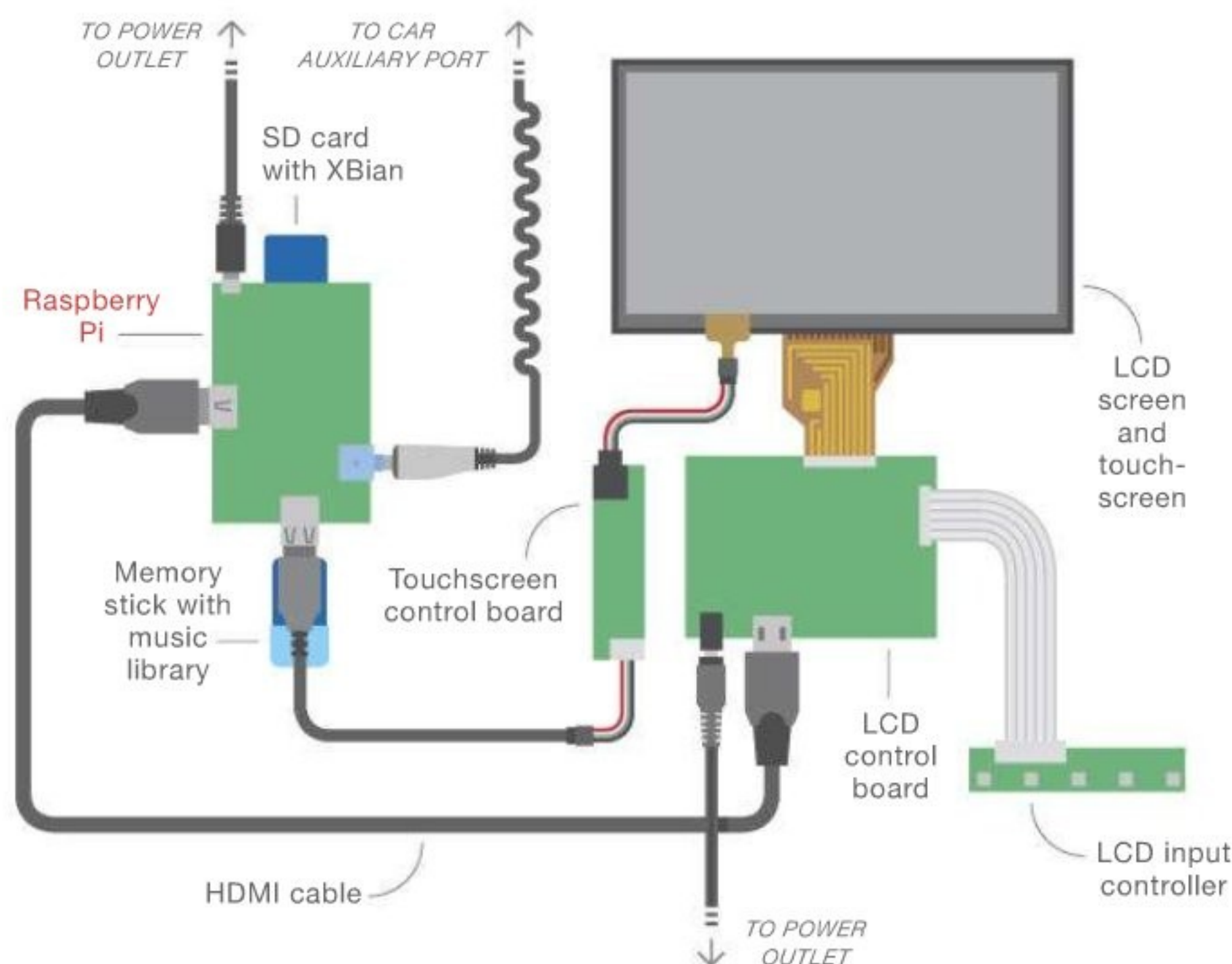
Have you ever been stuck in traffic and pulled up next to some maniac singing along with the radio to an audience of no one, index fingers drumming out a spastic beat on the steering wheel? That's me. As a married man living in a big city, I have a special affinity for my car's cloistered interior. It's a rare womb of privacy, a work-and-email-free bubble where I can reflect quietly or rock out as the day requires.



Dashboard music system

ASSEMBLING THE PI

The layout for your brand-new sound machine.



A few months ago I realised my haven was losing its appeal, and I sensed it was connected to my radio's anachronistic scan button. In a world filled with customised on-demand entertainment, the clunky AM/FM radio in my 2008 Ford is embarrassingly dated. I can pretend I'm Jay-Z all I want, but his ride has to feature a media centre with more than six FM presets.

So I decided to see if I could build a touchscreen dash personalised with thousands of my favourite songs using a Raspberry Pi, a computer board barely larger than a credit card. If you haven't heard of Raspberry Pi yet, remember the name – this easy-to-use microcomputer is taking over the programming world. Lauded by amateurs for its accessibility and by experts for its versatility, the Pi has been the catalyst for all sorts of cool projects: voice-activated coffeepots, self-watering plants... even touchscreen car dashboards.

You can find a Raspberry Pi online for surprisingly little. I ordered mine from the tech website adafruit.com. Setting it up for this project was fairly straightforward. The Pi is basically a Swiss Army Knife of inputs that you're already familiar with: HDMI and Ethernet connects, four USB ports, an audio and analogue video port, and an SD card slot. This last input is the most important because the Pi runs its operating system (known, a tad confusingly, as its "image") from an SD card.

MATERIALS

FOR THE RASPBERRY PI:

- Raspberry Pi Model B starter kit (includes 5-volt AC/DC power adaptor)
- 8 GB SD memory card
- USB keyboard
- Ethernet cord
- USB memory stick loaded with personal music library

FOR THE TOUCHSCREEN:

- Tontec 7-inch touchscreen (comes with control boards and wires)
- Tontec 12-volt power adaptor
- Masking tape
- HDMI cable

FOR THE INSTALLATION:

- Screwdriver
- Duct tape
- Foam board
- Standard auxiliary cable
- Radio harness extender
- External battery (5 000 mAh or higher) with multiple USB ports
- Micro USB cord
- USB-to-barrel plug (size 5,5 x 2,1-mm) cord

There's a bustling online community of Raspberry Pi coders who make pre-programmed images available for download. When I searched for images that would run a home-made media centre, a site called xbian.org had the most popular version: software for a media hub akin to what you see on an Apple TV. It can play music and movies, display pictures, and run other media apps such as Pandora – it can even stream content from Apple devices using AirPlay. Most conveniently, XBian can be played on any screen with an HDMI input, including the touchscreen I planned to build.

I popped an 8-gigabyte SD card into my laptop, and by following the step-by-step directions of the free installer I downloaded from the XBian website, I copied the image directly to my card. Then I ejected the card, slid it into my Raspberry Pi, and congratulated myself on becoming a genuine programmer.

Assembling the actual touchscreen – a Tontec seven-inch HD screen I found on Amazon for about R800 – was a bit trickier. The touchscreen comes with a primary control board that looks strikingly similar to the Raspberry Pi, plus two smaller control boards, all of which help communicate data to the Pi. The LCD screen and the glass touchscreen, meanwhile, don't come attached to each other because I guess that would make too much sense, so I had to connect them myself.

There's a rough guide online to making a touchscreen dashboard in which the author, a mysterious wise man identified only as Zaqq, explains how to do this with masking tape. I simply aligned the touchscreen atop the LCD screen, then ran tape along the centimetre-thick edges of the two stacked screens. For security I used five layers of tape, and I folded any excess neatly on to the back of the LCD screen.

To work properly, the touchscreen needs to be connected to its three control boards via three cables. Tontec does not include instructions, but each wire snaps exclusively into a specific corresponding jack, so I managed to connect everything using trial and error. Next I linked the touchscreen to my Raspberry Pi through HDMI and USB cables. I plugged the Pi into an outlet with its included power adaptor. The touchscreen didn't come with one, so I plugged it into the wall with a twelve-volt AC/DC adaptor I bought separately.

Both the Raspberry Pi and touchscreen turned on automatically. Then I had to get the XBian operating system synced with the touchscreen, and that required installing some drivers directly to the Raspberry Pi from

the Internet. To do this I plugged the Pi into my modem with an Ethernet cable, and, using the arrow buttons of a computer keyboard to control XBian (I connected the keyboard via USB), I highlighted the power icon in the menu screen and selected Exit. This closed the software and opened up the command terminal for the Pi.

Here is where things turn into a computer-hacking scene from a mid-nineties movie. The command terminal asked for a username and password. I entered “xbian” and “raspberrypi” respectively, then typed in a few gibberish-looking prompts recommended by Master Zaqq from that online guide. I’ll spell them out here in case you’re following along, but I strongly recommend supplementing these steps with your own Internet research.

In the terminal I entered `wget https://github.com/brantje/xbian-touch/raw/master/install.sh`, which downloaded the touchscreen driver, followed by `sudo sh install.sh`, which installed it to the Pi. After I complied with some onscreen prompts to orient the touchscreen, I was good to go.

The calibration of the touchscreen wasn’t as precise as I would’ve liked, but some tinkering would probably fix that. In the meantime I now had a slick media centre that could play my entire MP3 library, which I had stored on a 32-gigabyte flash drive that was plugged into the Pi’s second USB slot.

At last: the hard part. I suppose I should have assumed that installing the touch-

The author, seconds before connecting the touchscreen to the Raspberry Pi.



screen in a real car wouldn’t be as easy as programming the Pi. Without some practice, I was hesitant to disassemble my personal chariot, so I reached out to Brooklyn Automotive High School to see if they’d let me potentially ruin one of their practice cars. Always happy to assist a mechanical neophyte, the school, and in particular, a Renato Rosales of the school’s electronics class, let me mess around with a 2009 Pontiac G6 they’d been taking apart and putting back together for years.

My first step was to remove the car’s built-in radio, which was easy enough: with the help of Rosales, I popped off the plastic dashboard panel, unscrewed the radio, and yanked it out. Next I had to hook up my new media centre to the car’s sound system. This step varies from car to car, but in general you’ll need to connect the car’s speakers to the 3.5-millimetre audio jack in the Raspberry Pi. The simplest solution

is to use a standard auxiliary cable to link the Pi to the car’s auxiliary input, but this involves keeping the original radio connected (since it will be functioning as an amp).

You can stash the radio in your glove compartment or under a seat, though the latter will likely require you to extend the radio harness (the collection of wires that work the radio). For this step Rosales suggests you “get a stock harness adaptor that will plug into the vehicle’s existing wiring harness and splice into the audio outputs from there”. You can find harness adaptors at most electronics stores.

If your car doesn’t have an auxiliary input, the easiest fix is to move the radio as described above, then use a cassette-player auxiliary adaptor. It’s very last decade, but it should work.

Both the Raspberry Pi and the touchscreen need their own power sources. For this I’d recommend getting an external battery that’s 5 000 milliampere-hours or higher, with multiple USB ports. Raspberry Pi users seem to like Anker external batteries. Connect the battery to the Pi with a micro USB cord. Connect the touchscreen with a USB-to-barrel plug.

Once everything was connected and powered up, I took the Raspberry Pi, the control boards, and the wires and performed a fancy mechanical manoeuvre known by us programmers as “stuffing all of it into the empty radio cavity”. Finally I duct-taped the back of the touchscreen to a black foam board and secured that to the inside of the plastic dashboard panel.

When I snapped the panel back into place, the touchscreen sat flush with the dashboard and looked naturally integrated. The Pontiac had become 100 per cent cooler. After class some of Rosales’s students even admitted that the dashboard looked “pretty swag”.

It wasn’t until they scattered that I actually fired up the system, threw on some Jay-Z (okay, fine, it was Adele), and basked in the elation of DIY success. Was it easy? Not exactly. Is it possible? Yes, and I’m here singing to prove it.

THE TOUCHSCREEN ROAD-TRIP PLAYLIST

After completing this project, you will want to drive. This is the music.

The Sonics

“Have Love, Will Travel”
A driving beat, an outrageous sax solo, and washed-out guitars that sound the way a surfboard poking out of a hatch-back looks.

Johnny Cash

“I’ve Been Everywhere”
“... Reno, Chicago, Fargo, Minnesota, Buffalo, Toronto, Winslow, Sarasota, Wichita, Tulsa, Ottawa...”

Stone Temple Pilots

“Interstate Love Song”
A song for the moment when you notice how adorable your co-pilot looks chewing sunflower seeds.

Edward Sharpe and the Magnetic Zeros

“Home”
The song to sing in unison during the final five kilometres to your house.



STILTS!

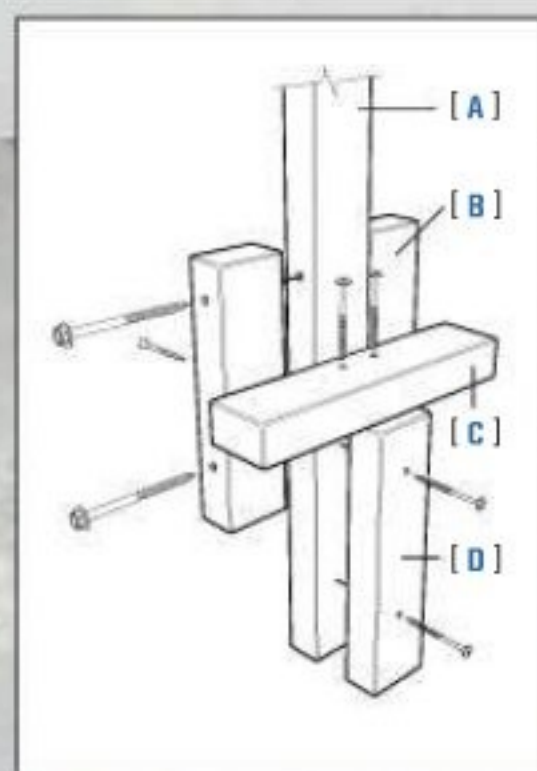
A project to build with your children. DESIGNED BY ROY BERENDSOHN

PROJECT NOTES

The key to this project is a sturdy design that's fast and simple to build. We were disappointed by our first few attempts to fasten the footrest. A 2 mm heavy steel bracket bent the moment we put any weight on it. Bolts and screws were stronger, but they either gave off disturbing creaking noises or loosened as we walked on them. It wasn't until we got to the current design, which has no through holes to drill or angled support brackets to cut, that we were satisfied with the footrests.

In terms of height, our first try was only 15 cm off the ground. We wanted to get stability and build under control before we worried about height. After that, we went up to 30 cm. Depending on the height of the child, you could go somewhat higher than that, but for safety, it's best not to go any higher than the child's knee. He'll need to step up to it without help, after all.

We wondered if we would need some sort of tread on the bottom of the stilts, but after walking a slick garage floor, a concrete sidewalk, and a lawn, we found that traction was not a problem. After only a few minutes of wear, the feet of the stilts roughened up enough to provide grip on most surfaces.



One issue we didn't expect was splinters. Construction lumber has to be carefully sanded where the stilt user puts his or her hands and where the body of the stilts rubs against the person's arms. Fortunately, a random orbital sander or even just hand sanding quickly takes care of the problem. While you're at it, knock off any sharp corners on

the footrests or support blocks.

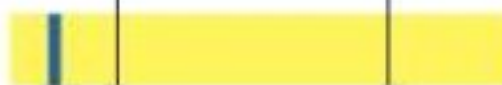
We had an 80 kg man walk around on these, so they should be more than capable of handling most children.



PHOTOGRAPH BY FRANNY AND ALBERT

EASY | REASONABLE | HARD

Difficulty:



Time: 30 minutes

Ages: 8+

Shopping list

QTY. | DESCRIPTION

3	50 x 75 x 200 posts
1	Box No. 10 x 75 mm Spax construction screws
8	6 x 125 Spax hex-head lag screws
	80-grit sandpaper
	120-grit sandpaper

Materials cut list

See diagram on previous page

A	2	50 x 75 x 125 stilts
B	4	50 x 75 x 225 side supports
C	2	50 x 75 x 275 footrests
D	2	50 x 75 x 25 bottom supports

TOOLS Mitre saw or circular saw, cordless drill, square, 3 mm x 15 cm drill bit, sander

Instructions

• parent only
• parent and kid
• kid only

1. Crosscut two 50 x 75s to the dimensions shown in our cut list [A, B, C, D].
2. Determine how high up you want the bottom support block to be. (We recommend anywhere from 30 to 40 cm, depending on the height, enthusiasm, and agility of the kid.) Then mark a reference line across the main stilt [A] and secure the bottom support block [D] below the line with two 8 cm construction screws.
3. Centre the footrest [C] on the bottom support block so that there's equal overhang on both ends. Secure it with two construction screws driven through the footrest and into the bottom support block [D].
4. Flip the stilt over and position the side support blocks [B] against it, centred on the footrest. Drive one 75-mm construction screw through the centre of each support block and into the footrest.
5. Turn the stilt on its side and use a 15 cm-long, 3 mm-diameter drill bit to make a pair of pilot holes through the side support blocks [B] and into the body of the stilt [A]. Drive a 6 x 120 mm lag screw into each pilot hole.
6. With a sander (or a square of sandpaper), use 80-grit followed by 120-grit to carefully sand the stilts where the user's hands will grip. If there are any sharp corners on the tops of the support blocks or footrests, reduce them with the 80-grit paper.

PM



PHOTOGRAPHS
BY
—
TOM
FOWLKS

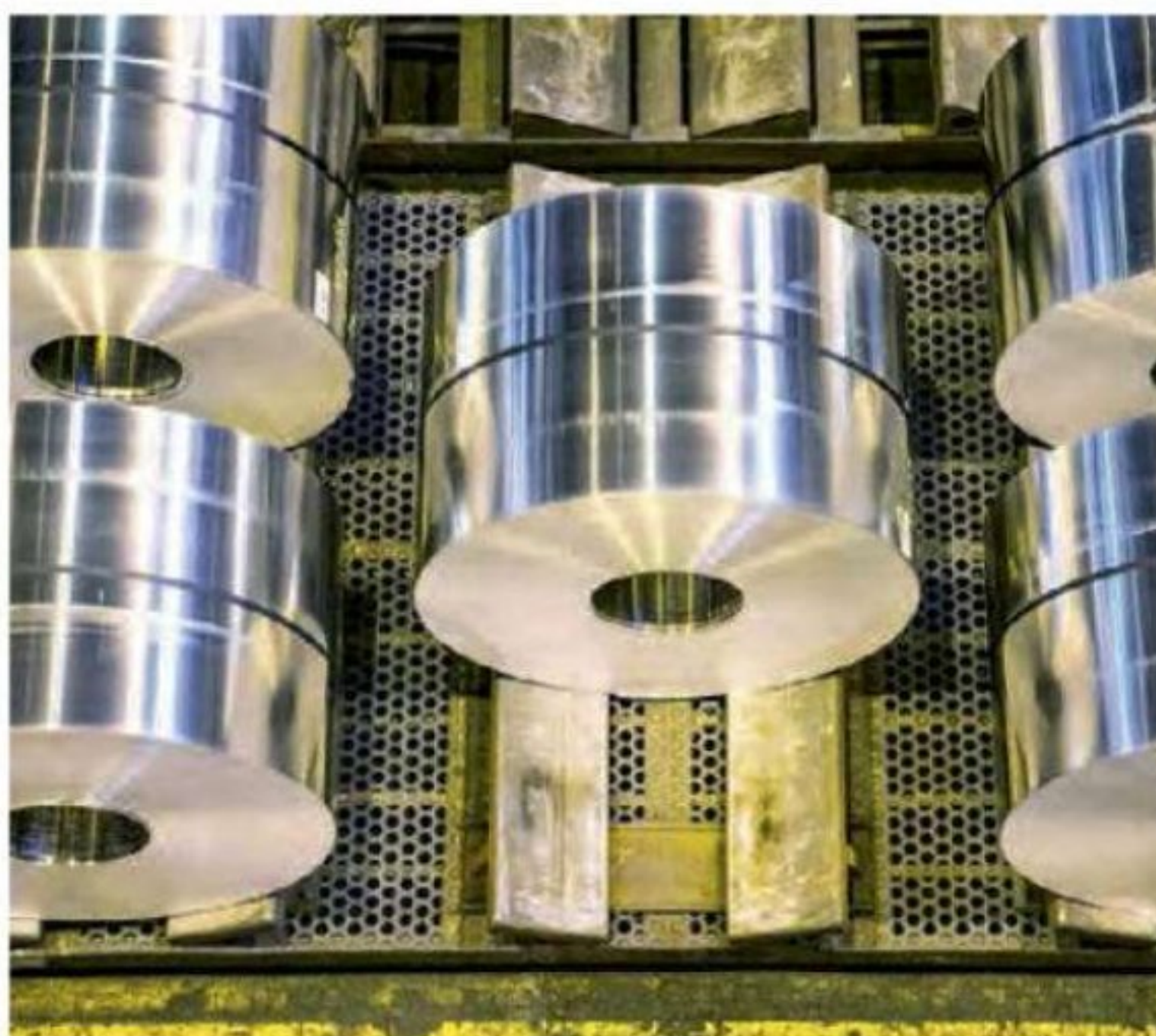
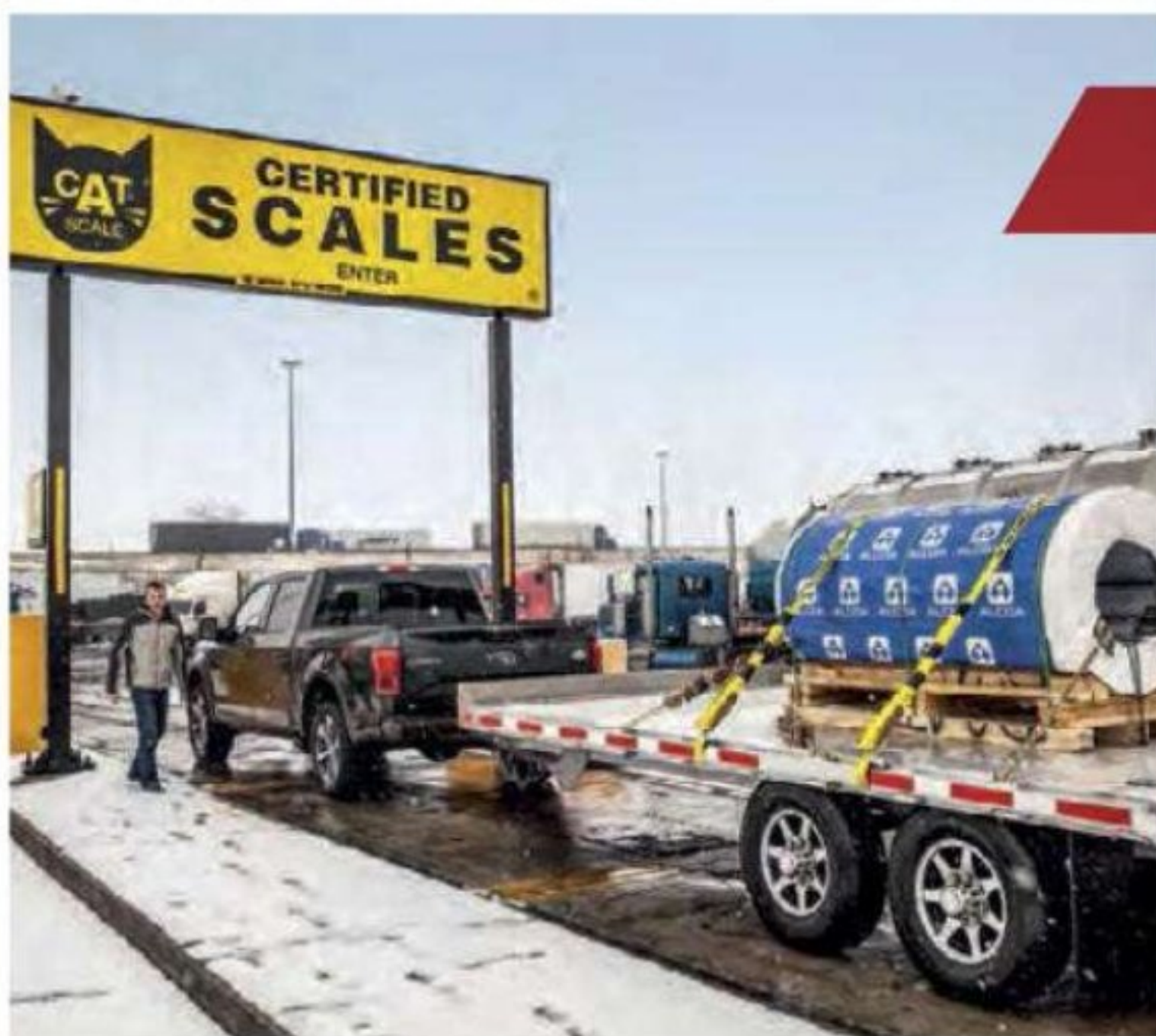
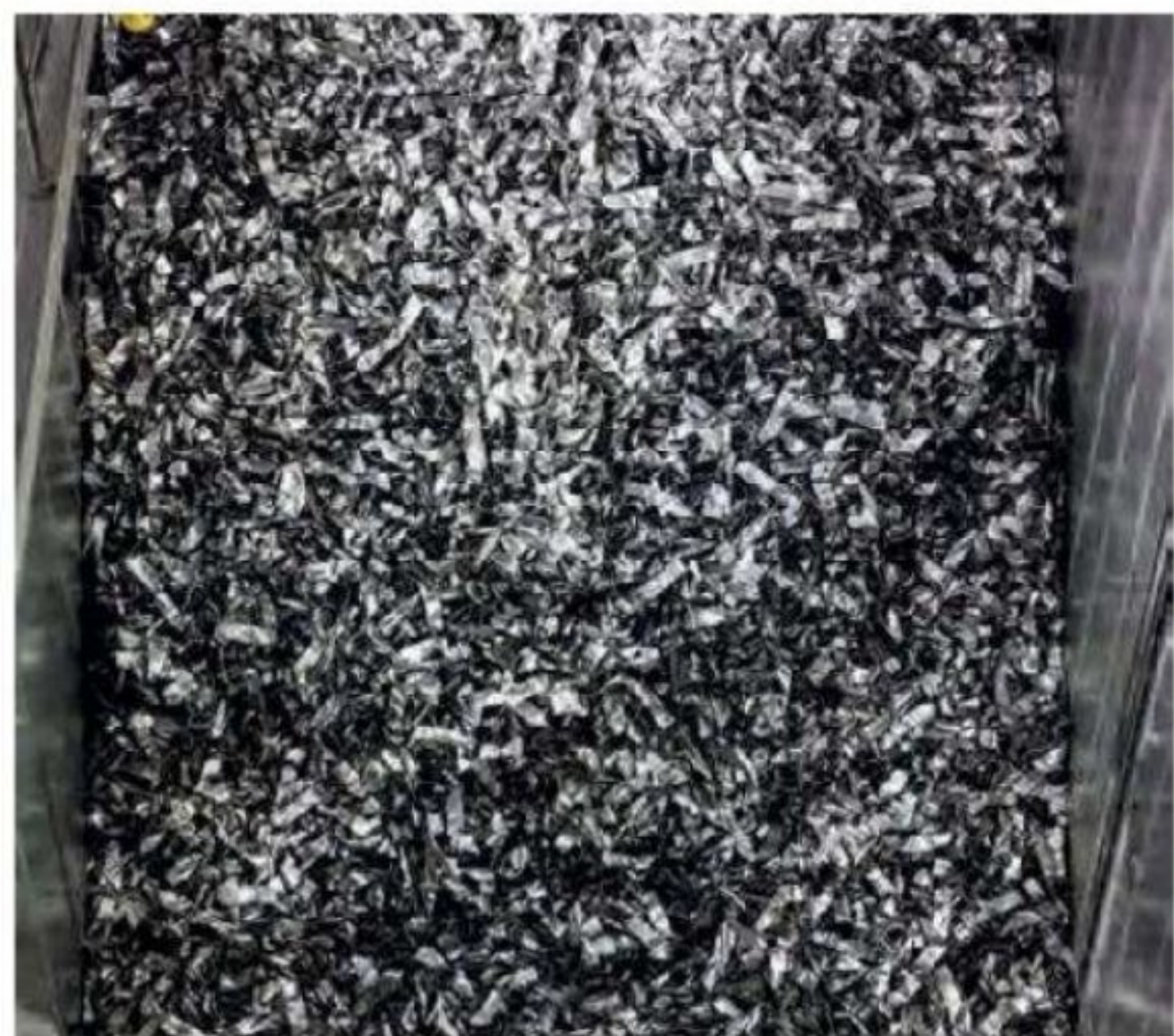
FINALLY, someone built an ALUMINIUM PICKUP TRUCK

BY
—
EZRA
DYER

People said it was a gamble. A huge risk. Why take the best-selling vehicle in America and start over? Because Ford knew what no one else did: the aluminium-clad 2015 F-150 was a sure bet all along. This is how you make a revolutionary bakkie.

Top row, from left: A crane operator at aluminium maker Alcoa's Davenport Works; the F-150's tow graphics show whether the truck is level; an ingot rolls into the hot mill. Middle row: A lighter body means better mileage; scrap aluminium is 100 per cent recycled; weighing in at a truck stop. Bottom row: Alcoa workers inspect the bed; the 360-degree camera is handy when you've got a six-metre trailer; rolls of high-grade aluminium.





You have to REMOVE YOUR WEDDING RING BEFORE YOU SET FOOT IN DAVENPORT WORKS,

the sprawling aluminium plant owned and operated by Alcoa, in Davenport, Iowa.

You have to wear safety goggles and earplugs, a hard hat, and steel-reinforced metatarsal boots. And you're happy for your armour, because this place is the Midwest heavy industry of your imagination – 54 hectares of beautiful cacophony along the banks of the Mississippi River.

At every turn there's a blast furnace disgorging molten aluminium, or a hot mill flattening ingots, or a 60-ton crane motoring overhead, all of it making you feel eminently tiny and squishable. The machinery at Davenport never stops, because the gooey, metallic lava pouring forth from the furnaces will become a door or a bonnet, eventually the whole damn body of America's most popular vehicle. Ford has decided to make the body of the 2015 F-150 out of aluminium instead of steel, which is what the body of every other pickup is made of, and what the body of every F-Series, the best-selling bakkie in America for thirty-eight years running and one of the best-selling vehicles in the world, had been made of since the first F-150 rolled off the line in 1975.

Last year Ford sold almost 740 000 F-Series pickups (the company does not break out individual sales figures) and there are an estimated 14,4 million F-150s on the road today. So when the Ford Motor Company decided to make the switch, Davenport Works got a lot busier.

I've come to Davenport not just to see how an F-150 is made, but to help build a few more of them. Over at the loading docks sits a 2 200-kg roll of automotive-grade aluminium on a tandem-axle flatbed trailer. That trailer is hooked up to a 2015 F-150 King Ranch 4x4. Later today I'll fire up the vehicle and set a course



for Ford's Dearborn, Michigan, stamping plant, where sheet aluminium is transformed into truck parts.

I'll use an F-150 to make more F-150s, because pick-up trucks are supposed to be handy, and Ford claims that the F-150's material metamorphosis makes it even more capable than its famously capable steel-bodied predecessor. With less of its own bulk to propel, the truck can haul more of whatever needs hauling – be it a boat, a load of mulch, or a two ton hunk of high-grade metal.

Davenport is excited about the F-150, and not just because it brought new jobs and a major upgrade to the plant. This place makes the metal for a lot of cool stuff – the wings on Air Force One came out of this plant, Alcoa helped develop the all-aluminium chassis for the Audi A8 and it supplies armour for military vehicles – but the final product is often an abstraction to the people who work here.

The F-150 is different. Half the pickups in the parking lot are F-150s. Out in the lobby there's a sign-up for an F-150 raffle dubbed "Lighten Up Already," with the "Al" rendered like the periodic table symbol for aluminium. The tickets are going fast.

After I have on all my safety gear, I climb on a golf cart with manufacturing director Rob Woodall. The golf cart is appropriate because Davenport's floor area is roughly equivalent to that of an eighteen-hole course under one roof. There's a network of roads inside, trafficked by forklifts and flatbed trolleys and employees riding industrial trikes just to get around. Mind the stop signs, because if there's something coming the other way, it'll probably be big.

They don't smelt aluminium at Davenport, but transforming recycled or new aluminium into a finished product still requires a lot of heat. A row of furnaces melt aluminium to be made into ingots and each

THE COMPARISON:

ALUMINIUM
ALLOY VS.
STEEL ALLOY

ALUMINIUM IS:

▲	55%	THICKER
▼	45%	LIGHTER
▲	30%	MORE DENT RESISTANT
▲	20%	STIFFER

Test sample: The
F-150's tailgate panel



time a furnace opens up it looks like you're gazing into the molten bowels of the Earth. The nearby pedestrian walkway is protected by plexiglass shields, lest a furnace's fiery exhalation relieve a passerby of his eyebrows.

The ingots are dull bars of aluminium about five metres long, two metres wide – your future truck in its crudest form. The ingot's next stop is for hot rolling at the reversing mill, a machine designed to mash that ingot down to a few millimetres thick. They never really told me why I had to take off my wedding ring, but the implication was ominous, and watching the hot mill at work, I can only imagine what incident precipitated that rule. Woodall parks the cart next to the hundred-inch mill, which makes two-metre-wide rolls of aluminium. "That's six storeys tall," he says. I eyeball the structure. It doesn't look that tall. "Three storeys of it are underground," he adds.

When an ingot goes into the mill, massive rollers pull it back and forth, a giant Fizzer getting longer and thinner with each pass until it's a flat sheet that's rolled into a huge coil at the continuous hot mill. The coil cools, aided by towering fans. Then it gets cold-rolled, so it's thinner still. Coils at various stages of the rolling process sit on racks of pallets that seem to stretch for half a kilometre.

After cold rolling the coils head to the new part of the works, the one that cost R3 billion, the point at which the primaeval belching furnaces give way to brightly lit finishing lines. Here the coils are unwound yet again, heat-treated and any wrinkles are pulled out. By now the metal is so thin and its surface is so smooth and pristine that a cushion of air supports the unwound sheet as it moves through the furnace before being re-coiled. The rolls, weighing between 9 000 and 18 000 kg each, are loaded by crane onto eighteen-wheelers. Meanwhile other trucks are arriving with scrap metal to start the cycle anew. This whole process is also

Alcoa's furnaces melt aluminium to be poured into moulds that form giant ingots, bars that then go into the mill for rolling.

playing out at another huge plant run by Novelis, 1 300 km away, in Oswego, New York. As massive as Davenport Works is, it's only half of the operation.

HERE'S THE THING about DRIVING THE 2015 F-150:

it's totally normal. That's what's so gutsy about Ford's decision to forgo steel, the metal of skyscrapers and battleships and Superman. The F-150 aluminium programme is a hugely challenging and investment-intensive technical endeavour, a manufacturing and logistic reboot for the most important vehicle in America, and the benefits are invisible.

I'm heading east on the I-80 interstate highway towing the trailer, doing 120 km/h, listening to the radio, cranking up my heated seat now and then. After about thirty seconds behind the wheel, you forget that your pickup, with its aluminium body and twin turbos, has more in common with a Bentley than it does a Chevy Silverado. What Ford did is akin to building a house with a blast-proof foundation – you know it's important, but it's not as overtly flashy as blowing your budget on a fancy gas oven and a whisky-stocked panic room.

You can tell that Ford is a little bit conflicted about how to promote its move to aluminium. They want to make a big deal out of it while simultaneously reassuring bakkie buyers they haven't done anything too radical. Ford's "Forward March" TV ad features Denis Leary growling about the new truck's aluminium body, yet the word aluminium is conspicuously absent from the F-150's window sticker – the list of features includes "fully boxed steel frame" yet makes no mention of that revolutionary body. If I were in charge at Ford, I'd offer the F-150 with no paint, like an Airstream trailer or a polished 747 fuselage. Loud and proud.

Aluminium costs more than steel, on a per kilo basis. Repairing it – and thus insuring it – might prove a little more expensive, too. But its advantages are huge. Aluminium doesn't rust. It can absorb more crash energy than steel. And – the main reason for this whole grand exercise – it's lighter. Even though a 2015 F-150 fender is thicker than a steel counterpart, it weighs 55 per cent less. Depending on the trim, 2015 F-150s lose as much as 300 kilos compared with the 2014 model.

Given the same power, the new pickup is quicker, it handles better and it stops shorter. Most importantly, it uses less fuel. And even if that improvement works out to only one litre per 100 kilometres across the board, millions of these vehicles could hit the road over the next few years. A little quick math suggests that the aluminium F-150 will save a billion litres of petrol within five years. By comparison, the Chevy Volt – an engineering feat in its own right – has saved more than 130 million

THE F-150: A BRIEF HISTORY



1970s

A 7,5-litre V8 gave this generation an edge over most other trucks.



1980s

The Twin Traction Beam front suspension is still controversial.



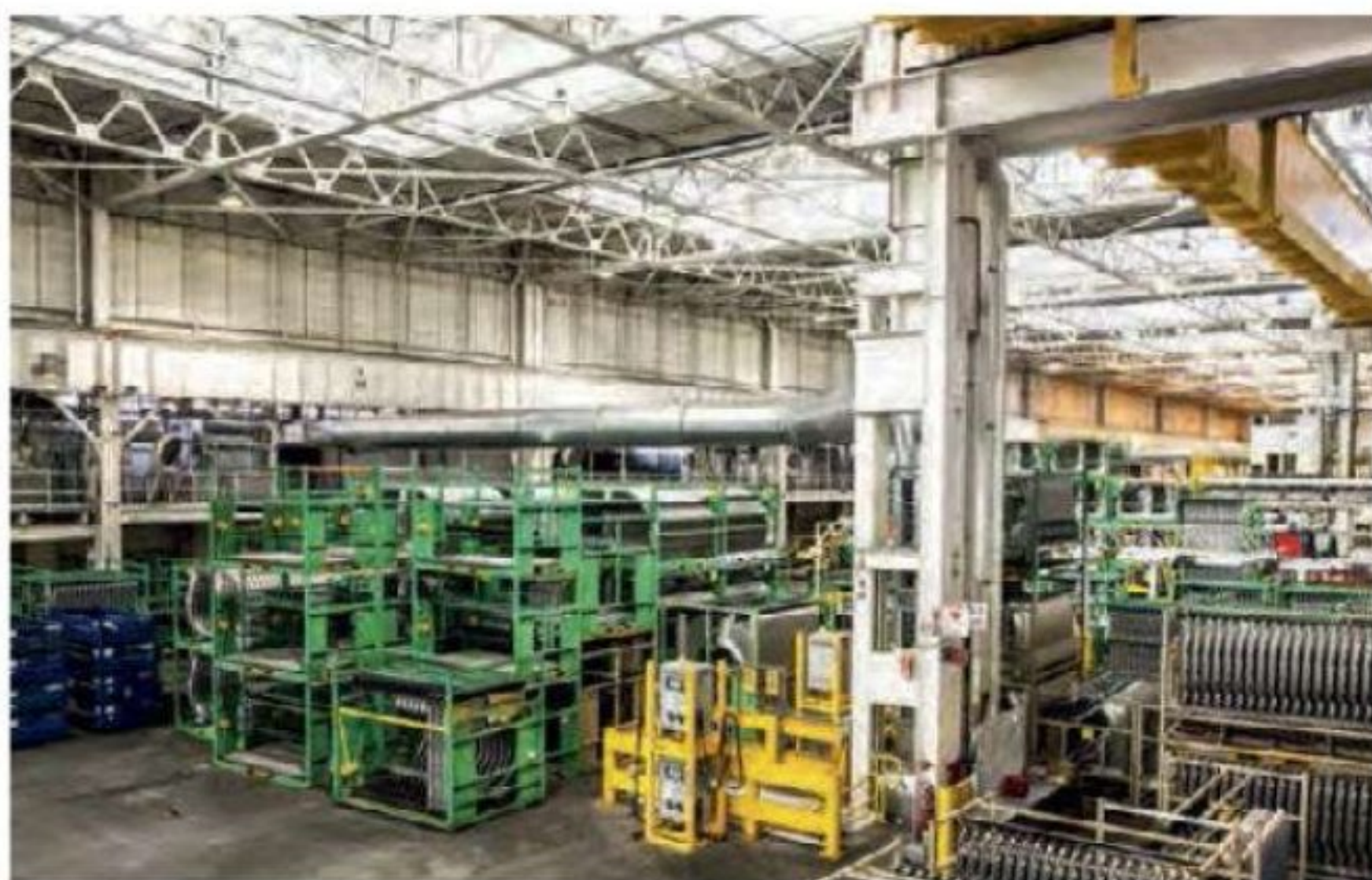
1990s

1997: overhead-cam V8s and real independent front suspension.



2000s

The F-150 adopts the big-rig styling that endures today.



litres, according to data collected from car tracking systems. Electric cars are great, but if you really want to dent the national demand for crude, you need to start with the bakkies.

This particular one, a loaded four-door King Ranch, epitomises the all-things-to-all-people role that pickups play in America. It's a luxury car, with heated and cooled leather seats, adaptive cruise control, and power-deployed running boards that pop out when you open the door. It's a family sedan, with seating for five and cup holders aplenty. The 3,5-litre EcoBoost V6 makes 272 kW and 570 N.m of torque, enabling a fair impression of a muscle car. And, yes, it's a workhorse – four-wheel drive, locking rear differential, and a decided indifference to the 3 000 kilograms or so hitched to the rear.

Although the F-150 is the lightest full-size pickup, with a kerb weight starting at a mere 1 837 kg (compare this with the previous F-150's 2 152 kg), my truck-and-trailer combo is just shy of six tons. I know this because I weigh it on a scale at a truck stop near Ottawa, Illinois. The fact that the V6 is dragging more than six tons at 120 km/h explains why I'm getting 23,5 litres/100 km. Which brings me to some advice for the F-150 shopper: A ninety-litre fuel tank doesn't take you far when you're towing. And stopping for petrol is exponentially more irritating when you have to navigate a trailer past the pumps. My kingdom for the optional 140-litre extended fuel tank!

After a little more than seven hours on the road, I pull into the parking lot of the Dearborn Inn, which was built on Ford property in 1931. Tomorrow morning I'll drive a few minutes down the street to the Dearborn Stamping Plant, where this bakkie's body was created from a roll of aluminium just like the one I brought from Davenport.



Left and centre: Freshly stamped F-150 parts – door frames, bumpers, bonnets – wait to be sent to Ford's Dearborn Truck Plant to be assembled into the lightest full-sized pickup body on Earth (right).

FORD'S ROUGE COMPLEX looks like A SET FOR THE CLIMACTIC BATTLE OF A JAMES BOND MOVIE:

It's a massive, imposing tableau of smokestacks, warehouses, and rail lines, the guts of the American car industry. Dearborn Stamping, located within, opened in 1939, and parts of the exterior haven't changed since. Shortly after I pull through the brick arches of the Rouge Complex entrance, a train rumbles past dragging flame-belching cauldrons of molten metal into the adjacent AK Steel plant. Steel isn't going away anytime

soon, but the stamping plant next door is devoted to the aluminium future. I park the truck and head in to meet the people who are tasked with reinventing the F-150, including a contingent from Novelis, which, along with Alcoa, helped devise Dearborn's elaborate scrap-recapturing system.

"We didn't just wake up yesterday and decide to build aluminium F-150s," says George Luckey, Ford's technical expert for advanced engineering and manufacturing processes. "We've been working on this for years. It goes back to when Ford owned Jaguar and built the aluminium XJ. Manufacturing that car taught us things that are relevant to the F-150."

Of course, pickups present challenges that don't show up on Jags. For instance, early prototypes used steel rivets on the bed. When the bed got scratched up, the aluminium wouldn't rust, but the rivets would turn into ugly orange warts. The solution: replace the rivets with spot welds and adhesives.

Dearborn Stamping engineering manager Jason Blosser leads us down to the spotless manufacturing floor, where coils of aluminium await their trip into the presses. The presses themselves are housed in what look like freestanding garages, with rail tracks leading to vast doors on each side. This is so the dies can be quickly swapped out when you want to switch the line from making, say, a fender to a tailgate. The



THE SMALLEST F-150

You don't expect much out of a kid's toy sold at Walmart, but let me tell you: the Power Wheels F-150 is pretty unstoppable. The secret? Monster Traction, which is Fisher-Price's term for what amounts to an electronic locking differential. After watching my 4-year-old motor out of an old golf course sand trap, I asked Fisher-Price how it works. In high gear the two motors at each back wheel are wired in parallel, with a hundred per cent of the battery voltage. So if one motor loads, it gets more current, meaning power goes to the tyre with traction. It works so well, my maniac kid drove it up a tree trunk and flipped over. Maybe the next generation should have a roll bar.



doors have windows, so you can walk right up and watch the magic as sheets of aluminium go in one end and bakkie parts come spitting out the other side.

First the metal is precut to the rough dimensions of whatever part needs to be made. That stack of blanks goes into the press. A many-tentacled robot uses suction cups to grab a piece of aluminium and place it in the press. Smash! Now it looks like a fender, and the suction cups grab it and move it down to the next die, which crashes down again and refines the shape. "For steel we used electromagnets to pick up the parts," Blosser says. "That obviously wouldn't work with aluminium, because it's nonferrous, so we had to go to the vacuum system."

I walk around to the output end of the press, where F-150 fenders are dropping on to the conveyor belt like Everlasting Gobstoppers pouring out of Willy Wonka's chocolate factory. Workers grab the fenders off the belt, inspect them, and place them on racks. They're slinging those fenders around like they don't weigh anything at all. "When a bed is fully assembled, tailgate and everything, you can lift it off the ground with one hand," Blosser says. Yet the parts are stronger than steel – depending on the chemical makeup of the alloy, aluminium can be the foil around your sandwich or the armour on your MRAP. Ford's stuff is closer to the latter. The alloys have improved a lot since the company started building prototype aluminium sedans in the early nineties.

Out here on the main floor we see the pickups taking shape, but in the basement is where you find a big piece of the business case for the aluminium F-150. As each part is stamped, the excess metal drops down a chute into a shredder.

Downstairs a 75-kilowatt fan blows the sorted scrap into tubes that run outside the building and into waiting eighteen-wheelers that return it to Oswego or Alcoa's Tennessee plant for recycling. This is a major reason why the aluminium F-150 makes financial sense for Ford: zero waste.

"It takes about ten times more energy to smelt aluminium than it does to start with recycled scrap," says Derek Prichett, global head of recycling for Novelis. So capturing the scrap is hugely important. And not just from a monetary standpoint but because the F-150 production requires so much. "On a typical automotive programme, say you're making a bonnet or something, you might need four million kilos of aluminium per year," Prichett says. "With the F-150... they'll need 350 or 400 million kilos a year. That's why there are two main suppliers. Neither of us on our own could handle it all."

All this effort – years of research, billions of dollars, new infrastructure from New York state to Iowa – all so that the F-150 could gain a few extra kilometres per litre. Ford took the lead to do the hard thing, forging a path that might not reap immediate rewards. After all, the F-150 probably would've remained a best-selling bakkie whether they made it out of aluminium or pig iron. Ford could've dangled a bright shiny object – a small diesel engine or trick new transmission – and won plaudits without really changing anything. Instead they went lightweight, engineering a force multiplier that will leverage all subsequent improvements – diesels, hybrids, ten-speed transmissions – to maximum effect. The new F-150 is the payoff for a plan years in the making, a machine of which Ford should rightly be proud. But it's also just the start. This is the foundation. **PM**

THE CONTRACTOR'S VERDICT

TOM LYNN IS A BOSTON CONTRACTOR WHO DRIVES A 2006 F-150. WE GAVE HIM A 2015 F-150 2.7 ECOBOOST 4x4 AND TOLD HIM TO PUT IT TO WORK. HERE ARE HIS THOUGHTS.

Small contractors often use their cab as their site office, and Ford obviously understands that. I love this cab. The console file cabinet is genius, and the plugs for computers and phones are in a compartment that neatly stores all of the wires. I'm actually writing this in the car.

In terms of power, the 2015 felt about the same as my V8-powered '06, but the fuel mileage is unreal. I'm certain that I used less than half the petrol I would have in my old truck. The way the stop/start engine shuts down at stoplights was weird at first, but it was never a problem, and the added fuel efficiency makes it worth it.

The bed works really well for the kind of jobs I do. The spray-on liner is awesome. I spill things, carry debris, and slide tools in and out all day. With this liner, you don't worry about scarring up the bed. The remote-locking tailgate is very nice, too. I usually use a tonneau cover over the bed and the ability to easily lock and unlock the tailgate is an asset.

The drop-down tailgate step is kind of cool, but it's another thing to break, and I'd probably prefer not having it. The plastic cover over the step came loose when I was unloading a snow plough. I drove the truck during the endless Boston blizzards, so I can vouch that it performs well in very deep snow. The wiper blades stay thawed, which isn't always a given.

Finally, this truck is a babe magnet. I'm old enough that the women aren't looking at me, but I'm sure I could have gotten a date with this truck. Let me know if you need a contractor's thoughts on a Maserati.

PHOTOGRAPH BY TONY LUONG



A BEAUTIFUL THING

VELDSKOEN

COMPANY:

Strassberger Skoene

LOCATION:

Clanwilliam, Cape



AS A SYMBOL OF SOUTH AFRICAN CULTURE, the veldskoen ranks right up there with the vuvuzela, the pointlessly outsize 4x4 and the Gatsby*. But, like so much else in life, the vellie seems to have fallen. Once ubiquitous to the point of anonymous, this homespun utility boot – famously turned into a fashion item by David Kramer – is being ousted by newcomers with a more **modern look**. It's called progress, folks.

The veldskoen is believed to have had its origins in Khoisan footwear, though is associated indelibly

with the Great Trek and is traditionally made from artisanal vegetable-tanned leather uppers on a rubber or crepe sole. Essentially classless, it is as at ease in the veld (duh) as in high society. It's even said to have inspired Clark's Desert Boot design.

The traditional model lives on at Strassberger Skoene (which styles itself the country's oldest veldskoen factory). Admittedly, it now has to share the production line with around 40 relative newcomers, from hiking boots to work shoes and sandals. The company was founded in 1834 on



the missionary station Wupperthal, 70 km from Clanwilliam. What was known initially as the Wupperthal Institute came under the leadership of German missionary Willy Strassberger, who brought on-board German shoemaker and tanner Konrad Buttner. The missionary's three sons founded the Gebroeders Strassberger and moved the base of operations to Clanwilliam, though to this day Wupperthal retains a small shoe factory.

The business fell on hard times after a change in ownership, going into liquidation in 2010 and leaving 45 families without an income. Fortunately, local financiers persuaded the old firm to regroup, jobs were restored, and today great-grandson JJ du Plessis presides over a vast range. Of course, you can still get that vellie (in red, blue or – gulp – purple). Clearly, they are doing something right: already licensed footwear suppliers to the Blue Bulls and Cheetahs supporters' clubs, they've been given the sole mandate to produce official Springbok supporters' shoes ahead of the 2015 World Cup.

*For those outside the Cape, this is something you eat.

PM

» Find out more: strassbergers.co.za «



THE

FUTURE

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2

3

4



A BALLOON TO THE EDGE OF SPACE

Even in this time of private rocket ships, space travel for most of us still seems a speculative, far-off dream. But World View Enterprises can get you there, at least to the edge of space, next year. Its helium balloon ride rises so high – to 30 000 metres, about three times farther up than commercial airliners fly – that you travel inside a climate-controlled capsule. As you lift off in Page, Arizona, cocktail in hand (there's a bar), you'll watch as the Grand Canyon yawns open. The park gradually shrinks away until you can see all of Arizona, then the entire American West. Then, finally, the curvature of Earth itself is revealed, and the planet floats below in its blue-green grandeur. The capsule includes Wi-Fi, so Instagram away: at the balloon's suborbital apogee, passengers will take in views previously seen by fewer than 550 people.

The trip lasts about six hours, two of those at maximum altitude. To descend, the pilot vents helium from the balloon, then releases it, shifting flight duties to an open parafoil. The capsule floats down from there, landing up to 500 kilometres from the launch site. They'll fly you back there in a small plane – all for \$75 000 (about R900 000). World View reaches and descends from these otherworldly heights using surprisingly retro technology: a polyethylene balloon and the kind of parafoil a skydiver would use, only much larger. The views, however, are all straight from the future. – CAMERON JOHNSON

OF



THE PERSONAL AIRCRAFT

Welcome to the era of the personal flying machine. The Icon A5 is a lustrous carbon-fibre two-person plane that takes off from and lands on water or paved surfaces, and whose wings fold up so it can be towed. Cofounder Steen Strand says production for the A5, which is 8 metres long and has a 10-metre wingspan, is starting this year. The R2,25-million craft has already tallied 1 250 preorders, and Icon plans to build 300 by the end of 2016.

Certification to fly the A5, which means getting a sport-pilot licence, takes about a week. A single stick, rudder pedals and a throttle manoeuvre the plane. It has a 75-litre fuel tank and can run on premium fuel, with a range of about 550 kilometres. It's the aeronautical version of driving a golf cart. "Flying is a fairly easy thing to do," Strand says. "Taking off and landing take a lot of practice. But just flying through the open sky is easier than driving your car down the road." – JOE BARGMANN



THE ELECTRIC SURFBOARD

If you've ever surfed or swum along with a wave headed towards shore and caught it just right, you know the feeling that comes when the water lifts you and hurtles you forward at a speed, and with a giddy force, beyond anything you could marshal on your own. Now there's a toy to simulate that feeling anytime, in any significant body of water: an electric surfboard called the Lampuga. The board, named for the fish better known as the mahimahi, one of the fastest in the sea, can whip you across the water at speeds up to 55 kilometres per hour.

Around 2,5 metres long, it looks like a slightly bulbous longboard. Inside the casing – a composite of carbon fibre and aluminium – sits a 10-kW electric jet-drive motor that sucks water from under the board and spits it out the back. The steering is controlled via a towrope. The handle has a thumb-operated throttle, so you can also sit or lie on the board and hold built-in handles. If you fall off, a magnet in the safety leash cuts power to the engine. On the R210 000 Lampuga, the waves never stop rolling – until it's time to plug in again. – CJ

ADVENTURE

CONQUER THE OCEANS! EXPLORE THE HEAVENS! SOON!



THE DIVING SUIT

You are a long way below the ocean's surface. The water's weight is enormous, yet you move easily in your aluminium-alloy suit. See something shiny on the ocean floor? Activate the thrusters on your back – two vertical, two horizontal – to glide to that spot. Your hand-like attachments are dextrous enough to snatch a coin off the bottom of a pool. Ready to head up?

Fire the thrusters again. And don't worry about the bends – the suit maintains a constant air pressure.

The gear that makes this adventure possible is called the Exosuit. Its creator, Phil Nuytten, founded a company focused on designing equipment to operate 300 metres underwater, where the suit's smallest rotary joint is subject to 5 711 kilograms of pressure. It's like taking a pick-up truck,

dropping it down on a 150 mm-diameter bearing, and expecting to be able to rotate it with your fingers, he says.

The first custom-built models shipped in 2014, and Nuytten put a production line in place this year. Customers include explorer Jean-Michel Cousteau. For the rest of us, a new world is about to float within reach. – KEVIN DUPZYK **PM**

PHOTO PRINTING

Because you can't appreciate a photograph if you never see it.



Start with the right gear

Your phone may be convenient, but it is not a camera. Even a point-and-shoot, while definitely an upgrade, won't get you the control or the advanced sensor you need to take great pictures. For a long time the DSLR, with its nearly instant autofocus and interchangeable lenses, has been the only choice for serious digital photography. But, in the past ten years a new category has gained popularity: mirrorless cameras such as the Sony a6000 (R12 500), above, remove the mirror that bounces an image from the lens to the eyepiece in a DSLR, instead relying on a digital viewfinder. Without the complication of a mirror, these cameras are lighter, more compact, and much less expensive than DSLRs, while producing nearly the same quality of image. You're the only one who has to know.



Do something with your pictures



- ▶ Like store them in a smart way that allows you to easily search and get access to them when you need to. First, forget the cloud. You'll have more immediate control over an external drive dedicated to your photos. The four-terabyte Western Digital My book (R2 800) has plenty of room, no matter how itchy your shutter finger. Plus, it lets you store everything in one place, not spread out over your computer, Facebook and photo sites. All you have to do is drag your photos to it after you import them.
- ▶ Pick a naming system and stick to it. Don't use dates. It's much easier to remember that you went to Kruger than it is to remember that you took a holiday in 2008. Group the images into categories such as birthdays and holidays. Each event gets its own folder, and each of those folders gets two folders: one for the originals and one for any corrected files.

SOMETHING TO CONSIDER

Digital deteriorates

If you still have any photos saved on CDs, move them to a hard drive, or at least put them on Dropbox, as soon as you can. As CDs age, their protective lacquer coating breaks down. This allows air to reach the aluminium and rust the disc, changing the chemical composition and eventually making it impossible to read the data.



INSTANT IMPROVEMENT » THE LIGHT METER

You may feel silly using it, but if you really want to get serious about taking photos, you need an incident light meter. It reads the light falling on to a subject directly from the source, as opposed to the light reflecting off the object and back to the camera (along with all the other light entering your camera lens). That lets you adjust your exposure to your focal point, not to the entire scene.

— IAN ALLEN, PHOTOGRAPHER



PHOTOGRAPHS BY DEVON JARVIS



Fix them

Think of this less as editing and more as processing. You're turning a negative into a developed photograph. Although the software that comes with some cameras can be quite good, don't worry about installing it. Every expert we consulted suggested Adobe Photoshop Lightroom, for \$10 (about R100) a month, or a free program called Gimp that offers almost all of the same features. A look at the key functions you'll find in both:



CROP: Remove distractions, but try to keep limbs and background objects complete. Use the classic rule of thirds to line things up by imagining a noughts-and-crosses board over the photo (like we did in the image above). Viewers automatically focus on the intersections, so try putting a subject's eyes along the top line. And keep it a little off-centre. Too much balance is boring.

EXPOSURE: Raising the amount of light brightens the image, bringing out hidden details in the darkness. Lowering it darkens the image, retrieving details that were lost in the light.

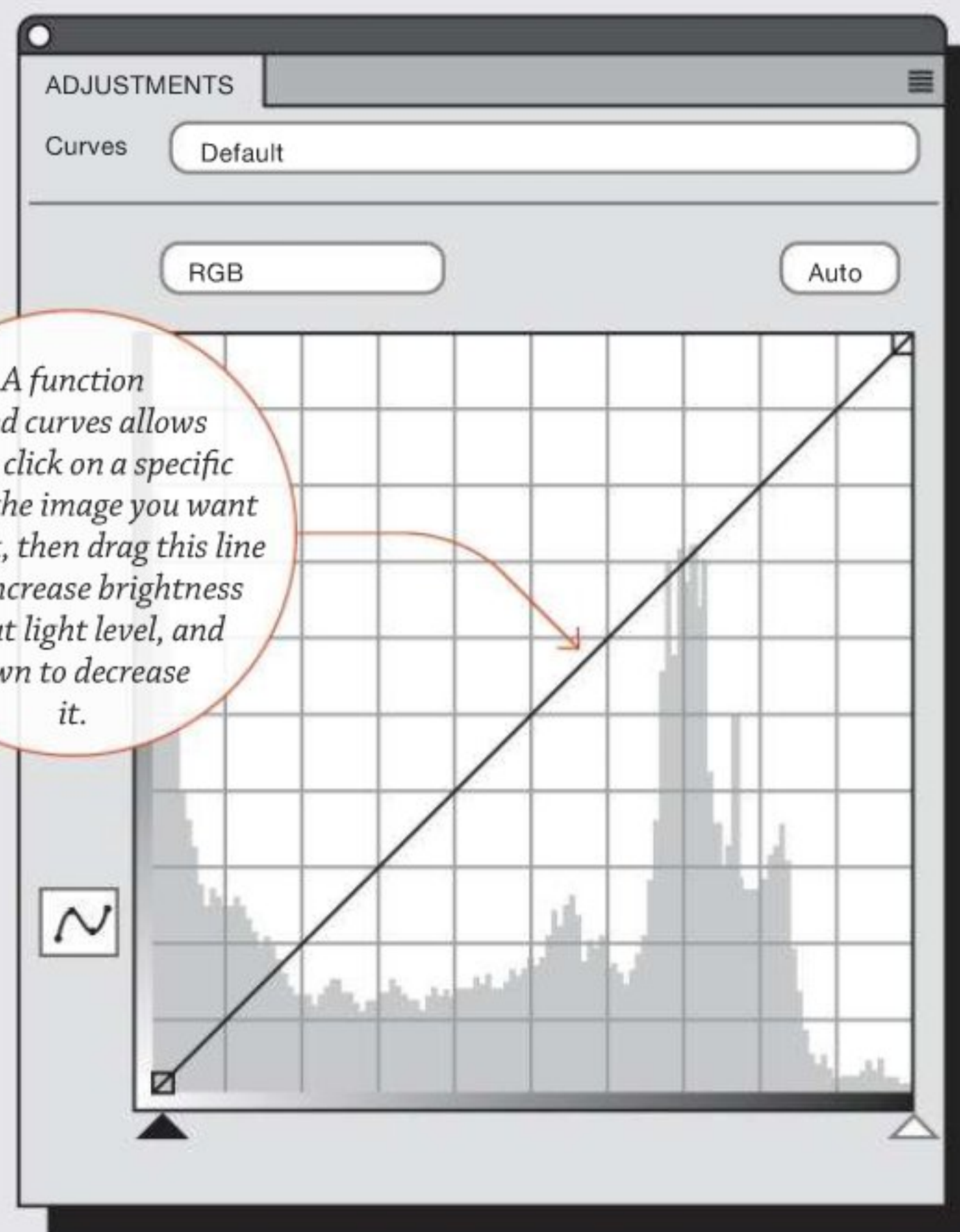
FILTERS: Reserved for amateurs. You're better than that.

EVERYTHING ELSE: Based on the histogram. See right.



INSTANT IMPROVEMENT » GET ONE GOOD LENS

Crappy lenses distort colour and cause fading at the edges of the shot. Start with a prime lens – this Sony E35mm F1.8 OSS E-mount fits the a6000 on the previous page – which will get you sharper photos and, since it can't zoom, will make you think about composition. You zoom with your feet. – ESTEBAN ALADRO, PHOTOGRAPHER



HOW TO USE A HISTOGRAM

► **THE VERTICAL AXIS** shows the number of pixels at each light level. (A night-time photo of a candle's flame will have high spikes to the left, since most of the image is in darkness, and a sunny beach shot will be shifted all the way to the right.) It depends on what you're shooting, but generally speaking, you want more of the pixels to be in the middle of the graph than on the very edges.

► **THE HORIZONTAL AXIS** displays the full range of brightness in an image, progressing from pure black, on the left-hand side, to pure white, on the right. There is a slider on the bottom of the chart. Move the left arrow to make the darks darker, and the right to make the lights lighter.

► **CLIPPING** If any of the spikes on the extreme right or left reach the top of the

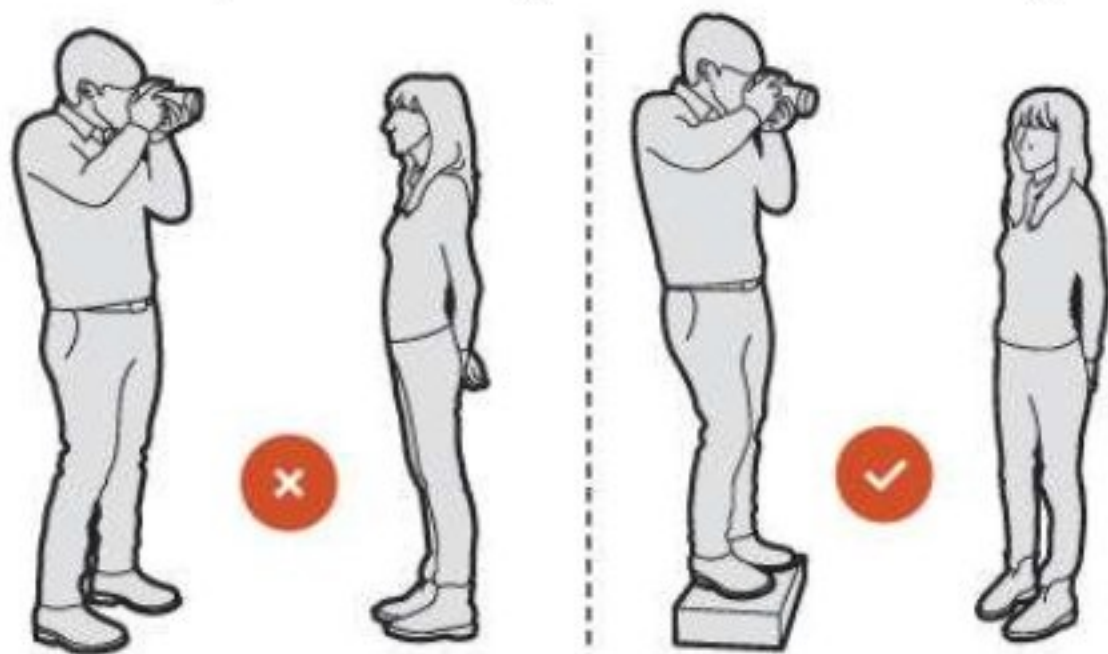
screen, that indicates that there are more of that type of pixel than the sensor could handle, which means you've lost detail. Shadows may be hiding texture, or something might be washed out in the Sun. It's a sign that you should have adjusted your exposure up or down to compensate when you took the picture.

► **COLOURS** Photoshop and Gimp let you pick specific colours and adjust their levels. Generally, you won't need to do this. There's an "auto" button that has earned its reputation. But if a photo still feels too warm (red) or cool (blue), you can adjust it with the colours function. Select the colour from the drop-down, then move the line in the appropriate direction to change saturation or brightness.

→ INSTANT IMPROVEMENT » USE ANGLES

If you look at actresses who know how to walk a red carpet, they turn their hips and legs away from the camera. That's because everyone takes a more flattering picture with their body rotated 30 degrees to either side. Also, if you can, shoot with the camera held slightly above eye level, at an angle looking down on the subject. Even better.

– ART STREIBER, PHOTOGRAPHER



4

Know which ones to fix

Whether you happen upon a great sunset or Sharlto Copley at the golf course, sometimes the best approach is to take multiple pictures of the same thing in the hope that one will turn out perfectly. But it's not always easy to spot the right one. A quick visual lesson:



Not only is the exposure better in the image on the right, but it also has better framing. The fence, cars and sign are distractions you don't want.



On the left, the sky is too bright and overexposed. You can't bring back those lost details. In the other shot, you'll be able to brighten the city and leave the sky as it is.



On the right, the guy in grey is the clear focal point, with a background that adds to the shot. On the left, he is just a blurry figure blocking the focal point behind him.

5

Get a good printer

After testing the major print shops, we found their quality to be below what you can do at home. Plus, at home you can catch details that didn't show up on your monitor, fix them, and print again. The Epson SureColor P600 (R11 000 est.) has a nine-colour ink system that easily handles even the subtlest shading. It's a pigment printer, which is usually the

better choice over dye. Pigment rests the ink on top of the paper; dye sinks in. Dye is slightly more vibrant, but unless you put it under UV glass, any exposure to sunlight will fade a dye image in a few months. Pigment-printed photos are rated for 200 years, even when on display.



6

And don't forget the paper

▶ Let the subject dictate which type to use.

ACTION SHOTS: For sports or wildlife, use glossed paper. The finish accommodates a range of hues, making details extra sharp, and the reflective coating makes subjects in motion appear even more dynamic. One warning: the glare makes glossy paper bad for framing under glass. You'll want to matte them instead.

PORTRAITS, LANDSCAPES AND BLACK-AND-WHITES:

Use matte paper because it adds a slightly dreamy quality. It also absorbs dark colours and handles varying textures that can get lost in glossy prints.

GIFTS: It's too expensive to use all the time, but double-weight photo paper is more durable and has heft and significance.

THE LOST ART

Passing around a photo

It's rude to keep swiping the screen after someone hands you his phone to look at a picture. But not with printed photos. Whether on a wall, in an album, or rubber-banded in a shoebox, printed photos are to be perused. If you're welcome in that home, you're welcome to those photos. Those photos were printed with the expectation – a hope, even – that they would be shared. And if they are passed around to other friends, ridiculed, and maybe pocketed to be used at a later birthday or nuptials, then they will be shared with even more people, just as they should be. Don't let storing images on phones warp your idea of what memories are for. And certainly not whom. **PM**

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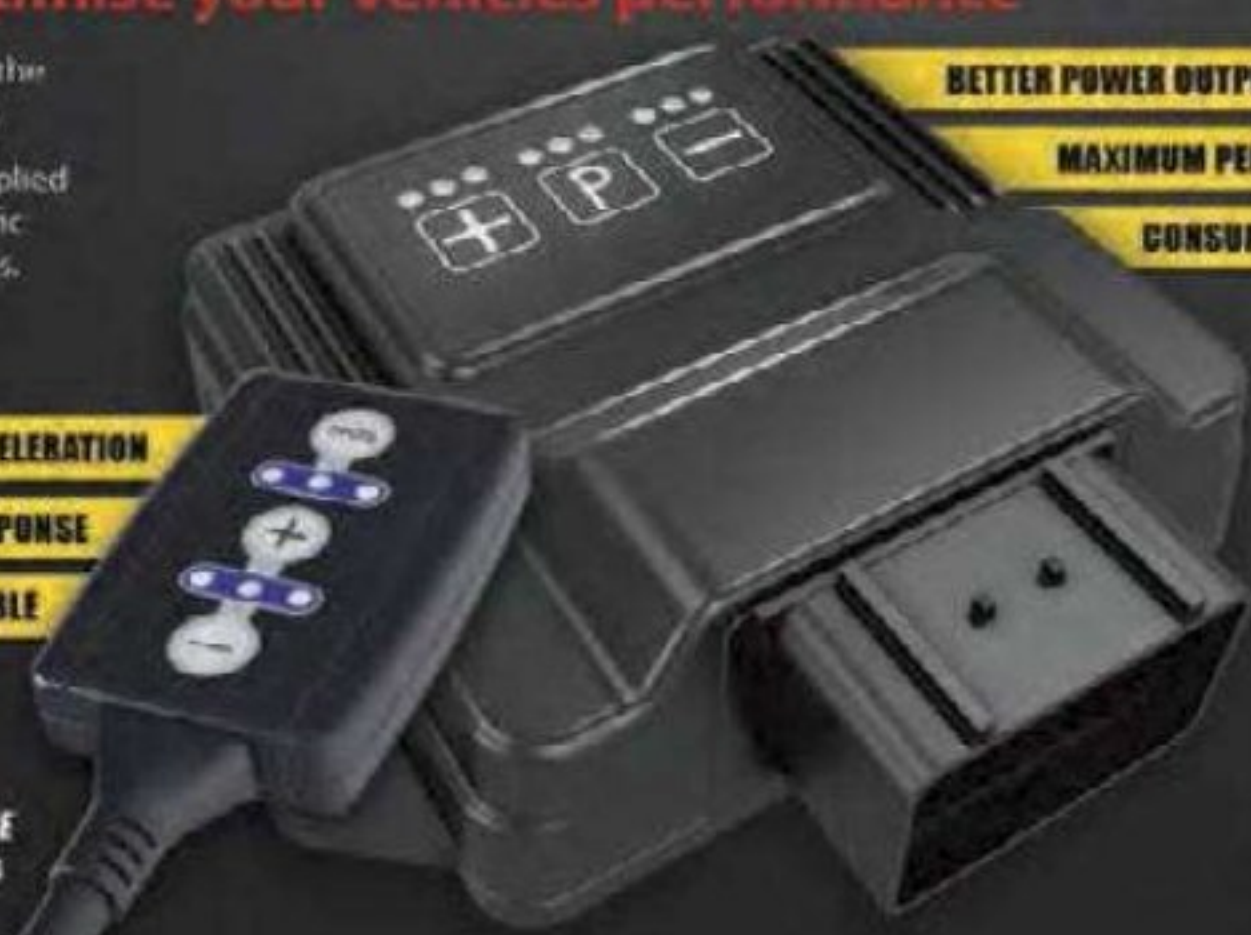
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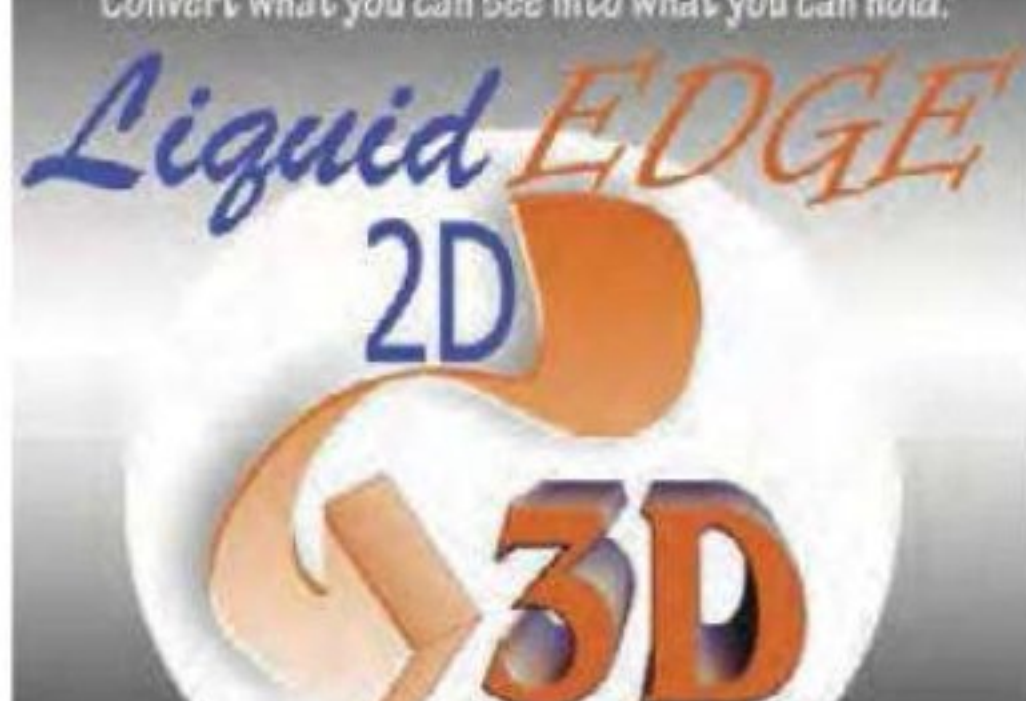
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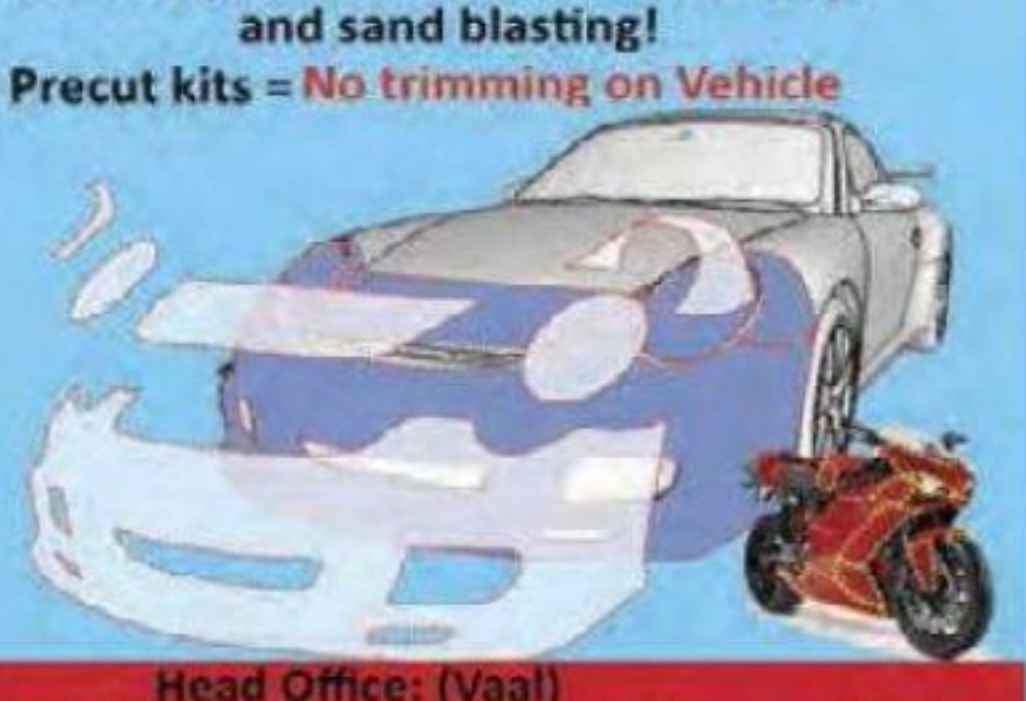
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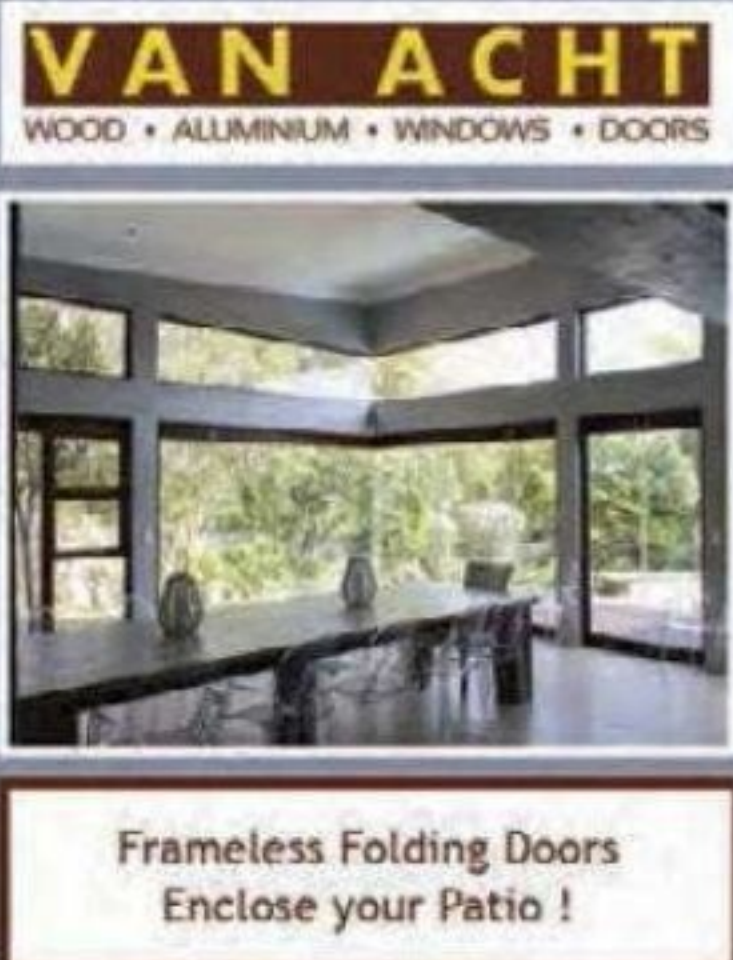
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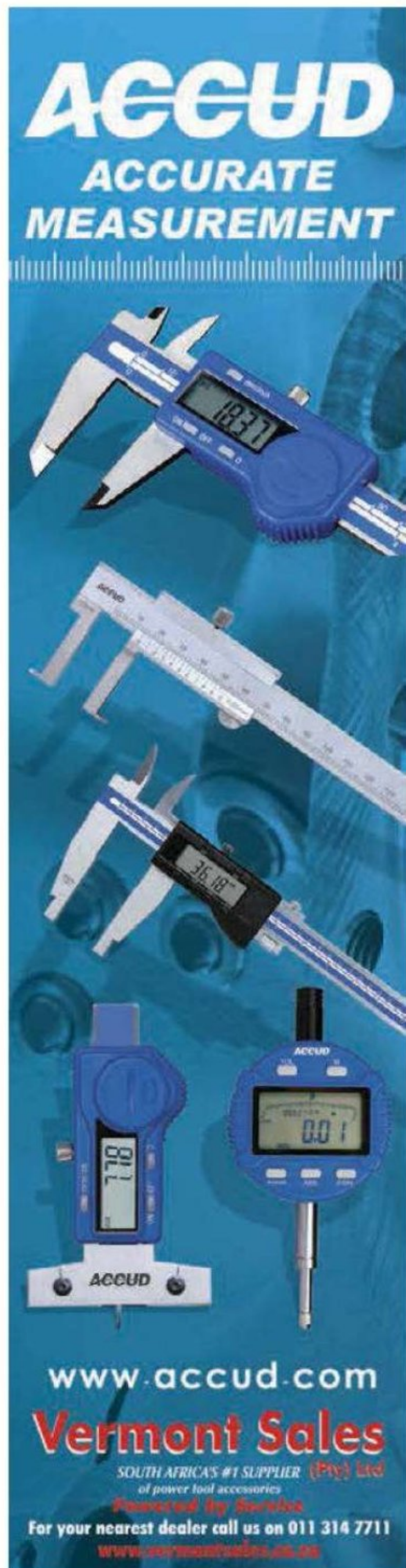
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WINNING TIP

DON'T LET THEM BUG YOU

This is for the bugs, spiders and other gremlins that get into your automated gate opener.

You need:

25 mm electrical conduit
2 end stops
2 screw-in caps.

Method: Cut 10 mm off one of the end caps and place to one side. Cut 100 mm of pipe and drill down its length any amount of holes of about 5 mm – whatever drill bit you have, really. Glue one end cap on the pipe. Now, drill a 25 mm hole in the gate opener housing, away from internal motor parts. Slide the pipe into the hole. On the inside, slide the 10 mm cutoff over the pipe and glue it in position, as this will hold the pipe. Fit and glue the second end cap inside the housing and screw in the end cap blank.

Now you can refit the gate housing cover, pop in four or five mothballs and screw on the outside cap. No more bugs in the motor or circuit board and you need to top up with mothballs only once every 2–3 months. **The best part:** no lock to undo or screws to lose.

MICHAEL CORKE
FISH HOEK

The cut off piece will be glued inside the motor housing, and the remaining part outside will hold the tube in place.



Tube fitted and ring glued inside housing with the other part outside.



Second end cap glued on with screw cap fitted inside housing.



Outside housing fitted and ready to pop in four or five mothballs.



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TAP FIX

My house is quite old and still has the original galvanised pipework and taps. This tip originates from a leaking bath tap that had a cracked seat where the tap washer seals when closed.

I tried to recut the seat, but found that no amount of recutting could solve the problem. The only solution seemed to be to remove the tap and replace it.

To do this, I would have to break out some of the outside wall to get in under the bath to remove the pipework and the valve. I decided to use some of that well-known brand of plastic steel epoxy that I had left over from another job.

I made sure the seat was nice and dry, mixed the steel epoxy and placed some on the seat all the way round. I waited for the epoxy to become like the texture of a marshmallow: soft, but not runny. Then I took the spindle assembly, with a new tap washer in place, smeared some oil on the tap washer assembly and inserted it in place.

After reassembling, I hand-tightened the tap spindle assembly until it was just touching the steel epoxy enough to form a new seat for the tap washer. When the epoxy had cured for about an hour, I secured the tap spindle assembly and the handle. Now I no longer have a leak, didn't have to break out any walls or replace a tap, and naturally saved a lot of money

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SMARTEN UP

After hanging new doors, then putting up the door striker plate, you always have a messy chiselled-out part on the inside of the striker plate, especially if you don't have the right

power tools, and you have to rely on the only chisel and hammer in your toolbox.

Well, to neaten it up, put some window putty in there and smooth it down. It looks neat and very professional.

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HIGHVELD

PLUGGED

I'm sure that, at some time, every DIY buff has had this problem: you've taken care to drill the right size hole to suit the plug, but when the plug is inserted it's loose in the hole. Either it just turns, or it pulls out as you tighten the screw. This happened to me the other day in a situation where I couldn't reposition the hole and try again. I had to be able to use the hole I had drilled.

I was using an 8 mm plug, so I cut a 6 mm strip of 120 grit water paper, folded it over the plug and pushed it into the hole. This time it was tight and I had to tap it home. It held perfectly and I was able to get a really good fix with the screw.

ROSS WILSON
CENTURION

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